

Demographic scenarios, residential mobility and impacts of climate change in the Alps

Intermediate report focusing on the Italian and, partly, Austrian Alps

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Note: unless otherwise specified in the text, ISTAT is the source of all data analysed in this report.

Introduction

The Fifth Report on the State of the Alps (RSA 5), produced during the Italian Presidency 2013-2014 and dedicated to demographic changes in the Alps, offered an up-to-date view of demographic and social changes in the Alps.

As bilateral Italian-Austrian initiative, the University of Turin (UNITO) – Department of Culture, Politics and Society (CPS) and the Austrian Academy of Sciences (ÖAW) – Institute for Interdisciplinary Mountain Research (IGF) in Innsbruck, signed a special framework agreement on international scientific cooperation –and launched in 2023 a first review to update some of the data contained in RSA 5.

Thanks to the collaboration of the Italian National Institute of Statistics (ISTAT) the possibility of updating the data on demographic trends in Italian Alpine municipalities has been ascertained. This will offer further and detailed information to guide Alpine policies for sustainable development, mitigation and adaptation to climate change, attention to the younger generations, combating the abandonment of rural and mountain areas and encouraging the processes of new population in the metro-mountain areas. On the Italian side, a further framework collaboration agreement was therefore signed between ISTAT, the Ministry of the Environment and Energy Security (MASE), and UNITO as well as the Permanent Secretariat of the Alpine Convention as Observer.

This activity intends to contribute in a pragmatic way to the achievement of Objective 6 of the Italian Presidency Programme, approved at the XVIII Alpine Conference: ‘Integration and updating of demographic, social and economic data from RSA 5 to guide policies for sustainable development in the sphere of climate change, for the promotion of mountain and rural territories, and for their repopulation’.

An initial update of the RSA 5 data was already carried out on the Italian side with respect to numerous fundamental indicators, with a parallel territorial in-depth study taking place on the Austrian side. This intermediate report is here presented. It is subsequently foreseen to include and analyse additional selected good practices in order to identify possible project responses to the phenomena of demographic change affecting the entire international Alpine arc. Finally, special attention has been paid to some innovative socio-territorial indicators, capable of highlighting the predictive impacts of climate change on certain demographic dimensions, in specific mountain contexts, with reference to the safety of residents and opportunities for the settlement of new inhabitants.

The working group involved in the research^{1a} adopted a quantitative methodology and a statistical approach to the analysis of the data. Data provided firstly by ISTAT was processed, together with additional and specific data from Italian and Austrian national sources, with respect to the main dimensions of population status, residential mobility, and the socio-territorial impacts of climate change in mountain communities.

This quantitative data represented the information basis for the realization of explanatory tables and detailed spatial maps – using the cartographic software QGIS – aimed at offering a clear and synoptic representation of the phenomena investigated.

^{1a} The working group is made up of some thirty researchers and analysts from ISTAT and UNITO, in close collaboration with the team at IGF Innsbruck. The group is coordinated by Andrea Membretti, together with Saverio Gazzelloni, Sandro Cruciani and Pier Paolo Viazzo, in close collaboration with Oliver Bender, Andreas Haller and Lea Held for the Austrian side.

1. The Italian Alps: demographic scenarios

Mauro Albani, Luca Biserna, Giorgia Capacci, Francesco Fabi, Antonella Guarneri, Andrea Membretti, Pier Paolo Viazzo (coordination), Roberta Clara Zanini

1.1 The Italian Alps in 2023: main demographic characteristics

Between 2013, when data were collected for the preparation of the Fifth Report on the State of the Alps (RSA 5), and 2023 the total population of the Italian Alps¹ has only modestly declined, as shown by Table 1.1, from 4,364,538 to 4,311,827 inhabitants (- 52,711, equal to 1.2%).

It will also be noticed from Table 1.1 that the number of municipalities has decreased from 1,749 in 2013 to 1,646 in 2023, owing to merging processes that have taken place over the decade and account for a very slight increase in the surface of the Italian territory within the perimeter of the Alpine Convention². Population density has therefore remained roughly the same, and so has the proportion of foreigners.

The weight of the working age population has, on the other hand, fallen from 64.1% to 62.6%. Even more markedly, the proportion of people aged 65 years or more has increased from less than 22% to over 25% and the population ageing index (the ratio between inhabitants older than 64 and younger than 15) has concomitantly moved upwards from 1.5 to 2.1 (Tab. 1.1).

Table 1.1. Main demographic characteristics of the Italian Alps, 2013 and 2023

	Population (Inhabitants)	Munici- palities	Surface (km ²)	Population density (In. per km ²)	Old Age Index (65+/0- 14)	65+ years old (*100 In.)	People in working age (*100 In.)	Foreign- ers (*1000 In.)
RSA 5 (2013)	4,364,538	1,749	51,995	83.9	1.5	21.8	64.1	78.7
2023	4,311,827	1,646	52,121	82.7	2.1	25.3	62.6	78.4

If we conduct an analysis by region, however, the picture that emerges for 2023 is quite heterogeneous. In particular, we find a higher population density in Lombardia and Veneto (128.6 and 107.4 inhabitants per km²) and higher proportions of elderly people in Friuli-Venezia Giulia, Liguria and Piemonte (29.1%, 29% and 27.9% respectively). The figures presented in Table 1.2 indicate that where the population is older, the working-age population tends to be smaller. We can also note that there are more foreigners in Liguria and Trentino-Alto Adige/Südtirol (102.6 and 95 per 1000 inhabitants), whereas Valle d'Aosta and Friuli-Venezia Giulia are characterized by low density and a lower incidence of foreigners.

¹ Throughout this Report, the term “Italian Alps” indicates the Italian territory within the perimeter of the Alpine Convention.

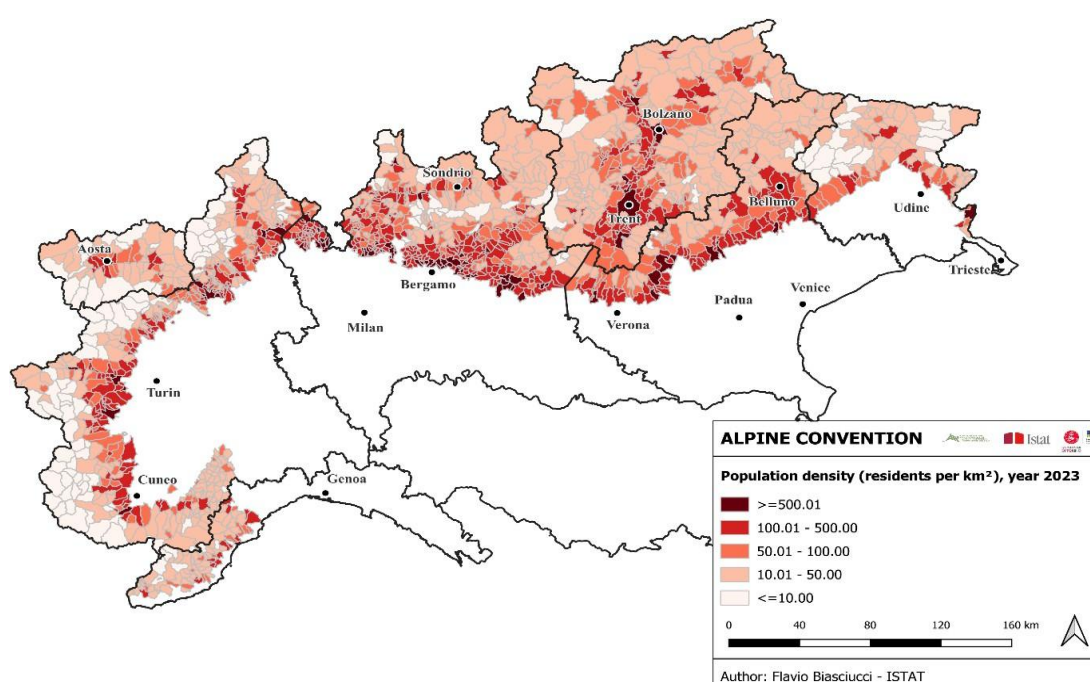
² It should be noticed that there has been no formal, legally binding decision, in any of the Alpine countries, on whether the perimeter of application of the Alpine Convention is to be modified according to these merging processes.

Table 1.2. Main demographic characteristics of the Italian Alps in 2023 by region.

	Population (Inhabit- ants)	Surface (km ²)	Population density (In. per km ²)	Old Age Index (65+/0- 14)	65+ years old (*100 In.)	People in working age (*100 In.)	Foreigners (*1000 In.)
Italian Alps (2023)	4,311,827	52,121	82.7	2.1	25.3	62.6	78.4
Piemonte	851,118	12,754	66.7	2.6	27.9	61.3	77.5
Valle d'Aosta	122,877	3,259	37.7	2.2	25.3	62.9	69.7
Lombardia	1,262,051	9,812	128.6	2.1	25.2	62.8	76.0
Trentino-Alto Adige/Südtirol	1,082,702	13,606	79.6	1.6	22.1	63.7	95.0
Veneto	708,362	6,596	107.4	2.2	25.9	62.5	78.6
Friuli-Venezia Giulia	203,384	4,515	45.0	2.8	29.1	60.6	72.5
Liguria	81,333	1,579	51.5	2.8	29.0	60.7	102.6

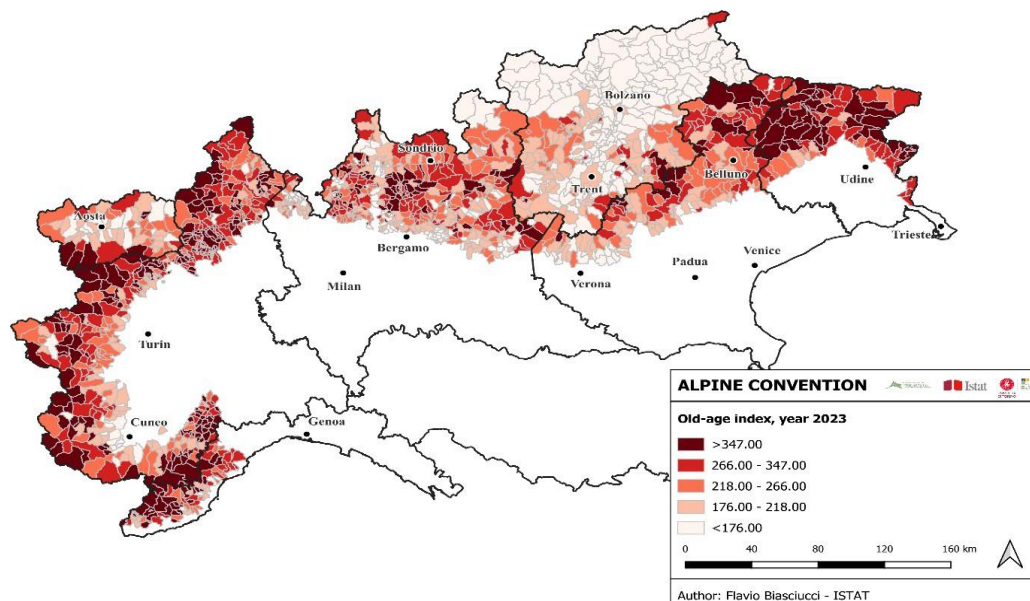
A different, more detailed and spatially far more revealing representation of the information provided in Table 1.2 is offered by Figures 1.1, 1.2 and 1.3.

Figure 1.1. Population density in the municipalities of the Italian Alps (2023)



While visually confirming that population density is especially low in Valle d'Aosta and Friuli-Venezia-Giulia, Figure 1.1 shows that the number of residents per km² tends to be higher in peri-urban areas, most clearly in Lombardia, Trentino and Veneto. Overall, population density, which has slightly decreased in the last 10 years (as signaled by Table 1.1), remains well below the national average of 195.3 inhabitants per km².

Figure 1.2. Old age index in the municipalities of the Italian Alps (2023)



As with population density, a cartographic representation at the scale of single municipalities vividly confirms what had already been indicated by Table 1.2, namely that the Alpine municipalities of Liguria, Piemonte and Friuli-Venezia Giulia display the highest ratios between inhabitants older than 64 and younger than 15. This map also impressively shows that the youngest population is to be found in Trentino-Alto Adige/Südtirol: as suggested by Table 1.2 and by Figure 1.3 below, this is largely accounted for by the high incidence of foreign residents.

It can be noted that in the six municipalities where the elderly population is close to or exceeds the 50% threshold the number of inhabitants is very small (in all but one case less than 130) and the degree of urbanisation³ is very low⁴. And also, that of the six municipalities with more than 70% of inhabitants in the working age bracket⁵, the two largest ones – Livigno and Sestriere, which count 6,807 and 901 inhabitants respectively – are both ski resorts, whereas the other four have at most 318 inhabitants and

³ The degree of urbanisation (DEGURBA) is a classification of Local Administrative Units (LAU) – based on a combination of geographical contiguity and population density – that indicates the character of an area. It classifies the territory of a country on an urban-rural continuum, dividing the territory into three types of areas: cities (densely populated), towns and suburbs (intermediate density) and rural areas (low density), based on population density and the geographical contiguity of 1 km² cells. Local administrative units are classified according to the percentage of the population residing in urban centres, urban agglomerations or rural cells, and these classifications are used to describe the urban-rural character of an area (https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Degree_of_urbanisation).

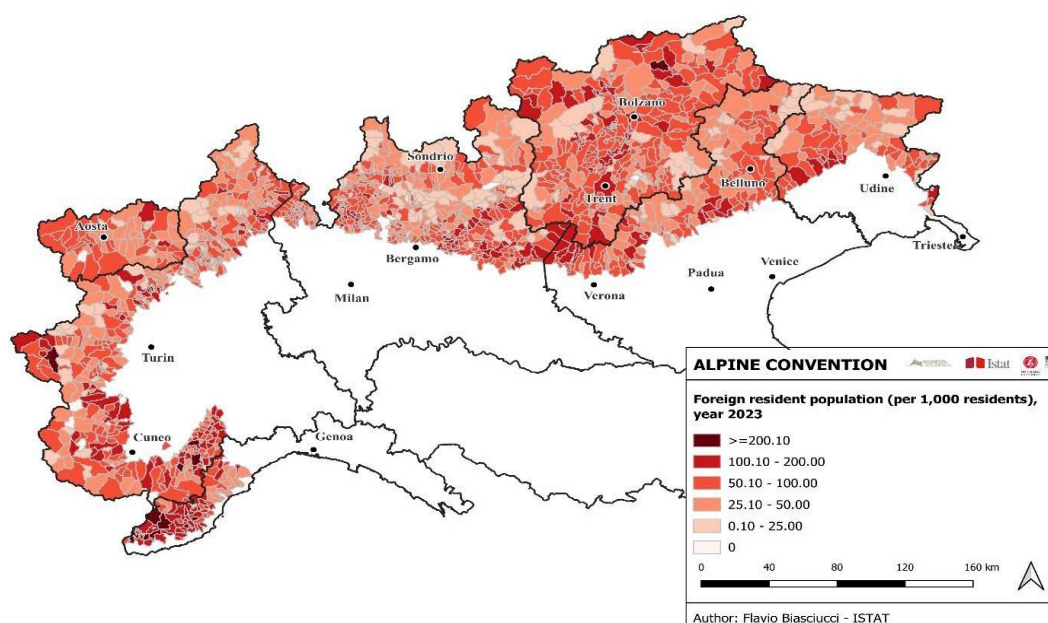
⁴ The six municipalities are Drenchia (UD), Ribordone (TO), Pamparato (CN), Torresina (CN), Tramonti di Sopra (PN) and Magasa (BS).

⁵ Alto (CN), Lauregno and Sestriere (TO), Livigno (SO), Ponte Gardena/Waidbruck (BZ), Vessalico (IM).

are characterized by a low degree of urbanization. A detailed examination of these and other extreme cases brings out a great variety of situations even within the same provinces, in accordance with what had already been observed in previous years. It is finally worth stressing that over the past ten years the difference between the working-age population at the national level and in the Alpine area has grown significantly from 0.7% in 2013 to 3.8% in 2023.

In fact, at the national level in Italy, the working-age population was approximately 66.4% in 2023, while in the municipalities of the Alps it was 62.6%, highlighting a +3.8% difference in favor of the national level. In contrast, in 2013, this category was 64.8% at the national level, compared to 64.1% in the Alps, with a smaller difference of +0.7 percentage points. There therefore appears to have been a significant decline in the working-age population in the Alpine area over the decade compared to the national trend.

Figure 1.3. Foreign resident population in the municipalities of the Italian Alps (2023)



The share of foreigners in the Alpine area in 2023 was around 78.7 per 1000 inhabitants, almost exactly the same as ten years earlier (78.4). It may be noted, however, that compared to the national level (87 per 1000 inhabitants in 2023, 83 in 2013) the difference has widened. We had seen from Table 1.2 that in 2023 Liguria was the region with the highest incidence of foreign residents. This is visually confirmed by Figure 1.3, and three of the five municipalities where the share of foreign residents approaches or exceeds the level of 300 per 1000 inhabitants are indeed part of the Ligurian province of Imperia⁶.

⁶ The five municipalities are: Bajardo, Airole, Lucinasco (IM), Fortezza/Franzensfeste (BZ) and Campione d'Italia (CO). The two largest municipalities are Campione d'Italia and Fortezza (1,757 and 1,101 inhabitants), whereas the other three have populations ranging between 308 and 378 inhabitants. The degree of urbanisation of these municipalities is in general low.

1.2 Population growth, 2014-2023

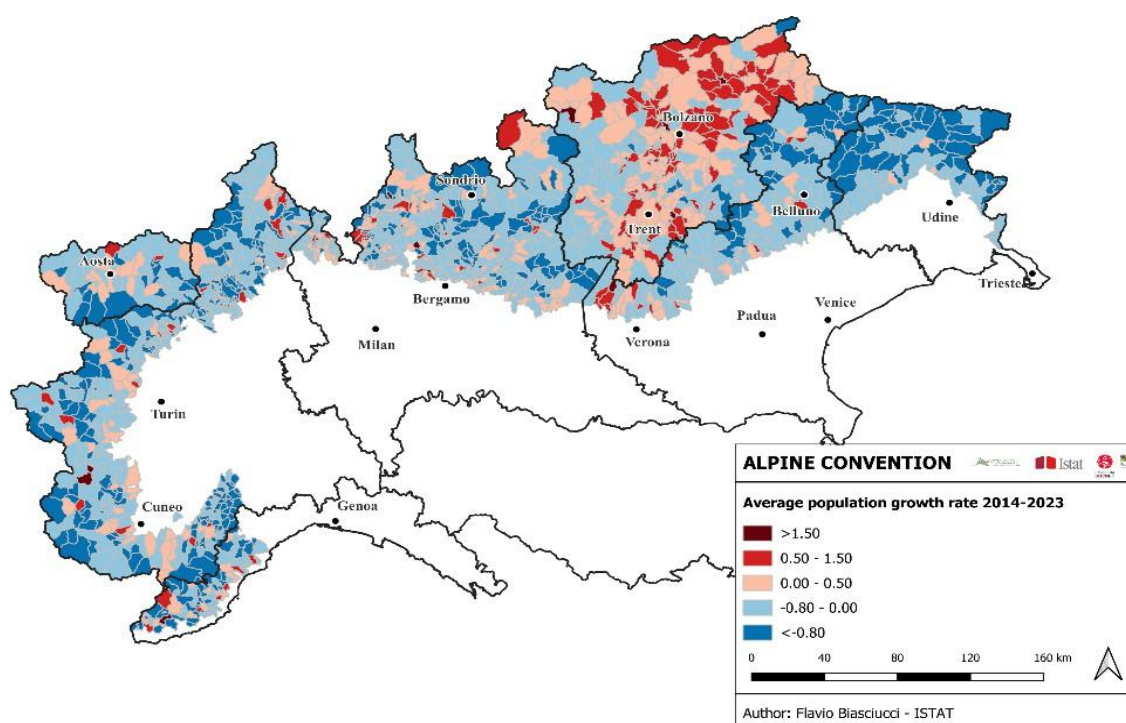
The annual average rate of increase/decrease of the Alpine population in Italy between 2014 and 2023 was equal to -0.43%. Of course, the situation is quite diverse across the Alps, but depopulation is clearly a problem. The majority of the municipalities in the Italian Alpine area show population loss or stagnation, with growth rates of the resident population equal to zero or negative.

Table 1.3. Growth rate, natural balance and migration balance in the Italian Alps by region, 2014-2023

Italian Alpine Regions	Average annual population growth rate	Natural balance (per 1000 inhabitants)	Migration balance (per 1000 inhabitants)
Piemonte	-0.68	-99.07	29.96
Valle d'Aosta/Vallée d'Aoste	-0.53	-49.69	5.58
Lombardia	-0.37	-52.84	14.13
Veneto	-0.48	-56.77	11.30
Friuli-Venezia Giulia	-0.90	-103.74	12.33
Liguria	-0.66	-104.05	30.13
Bolzano/Bozen	0.40	21.88	16.57
Trento	0.04	-22.48	33.40
Italian Alps	-0.43	-63.11	20.73

In a general landscape of depopulation, an exception is represented by the province of Trento and, even more, by the province of Bolzano/Bozen that both show a positive population growth rate (respectively +0.04 and +0.40%). The striking contrast between these two provinces and the municipalities of Friuli-Venezia Giulia, Piemonte and Liguria, where depopulation is particularly severe, catches immediately the eye when looking at Figure 1.4.

Figure 1.4. Average population growth rate in the municipalities of the Italian Alps, 2014-2023.



A different and very informative perspective on population growth or decline can be obtained by adopting the Eurostat territorial classification that merges the altitude of the municipalities with their degree of urbanisation (*Degurba*). As shown by Table 1.4, the only dynamic areas turn out to be the ones with altitude > 700 m and Medium-High *Degurba* (+0.12), whereas the areas that grow less are the ones with altitude ≤ 700 m and Low *Degurba* (-0.52).

These are intriguing and potentially highly important findings, which definitely deserve further and more refined investigation.

Table 1.4. Growth rate, natural balance and migration balance in the Italian Alps by territorial classification, 2014-2023

Territorial classification (altitude centres + <i>Degurba</i>)	Average annual population growth rate	Natural balance (per 1000 inhabitants)	Migration balance (per 1000 inhabitants)
Altitude centres ≤ 700 m and Medium-High <i>Degurba</i>	-0.24	-42.91	21.79
Altitude centres ≤ 700 m and Low <i>Degurba</i>	-0.52	-71.70	18.41
Altitude centres > 700 m and Medium-High <i>Degurba</i>	0.12	-27.32	37.85
Altitude centres > 700 m and Low <i>Degurba</i>	-0.47	-69.92	22.25
Italian Alps	-0.43	-63.11	20.73

1.3 Population balance

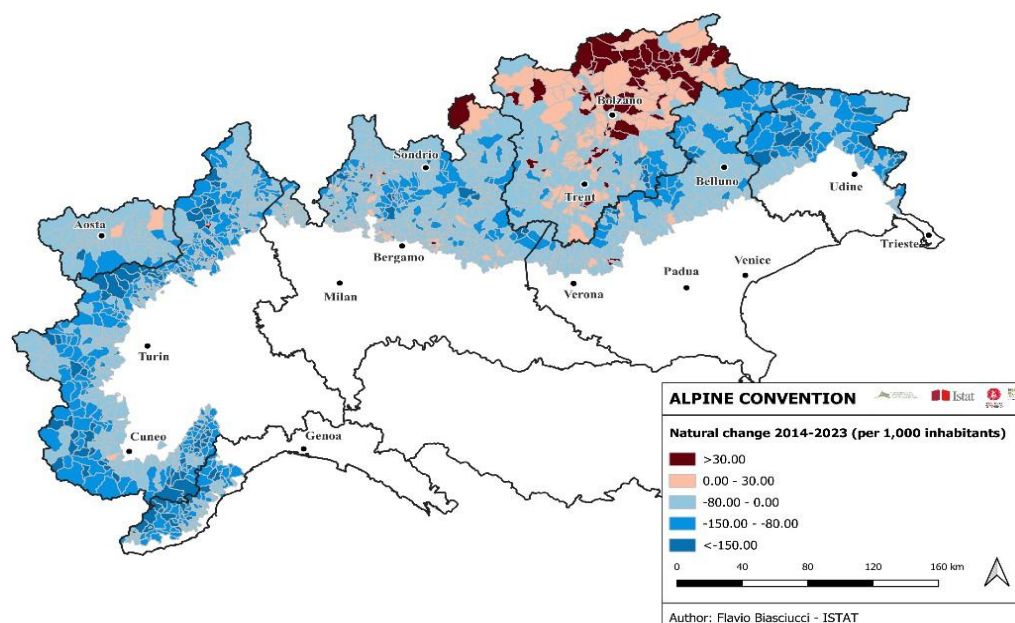
Population balance is influenced by trends in fertility, mortality and migration. For this purpose, we consider separately natural and migratory change.

Natural balance (the number of live births minus the number of deaths) is associated with the inputs and outputs from the population stock due to natural causes (births and deaths). This factor is therefore influenced by population structure, in particular by the percentage of elderly people in the total population. This influence can be clearly observed in the Alpine area, where lower values of natural change are found in areas with a high ageing index. Natural population changes are not only linked to the population age, but also to other factors, such as familial and reproductive behavior.

Among other factors, the presence or absence of essential services of foundational economy which may encourage women to have children and start families – such as health-related services, schools and public offices – can crucially affect natural change. In general, the municipalities with the lowest natural population growth are mostly located in the more remote or less economically dynamic areas, whereas the faster-growing areas tend to be closer to urban centers or better-connected regions.

When considering the Italian Alps as a whole, the natural balance for the period 2014-2023 is negative (-3.11 per 1000 inhabitants). As shown by Figure 1.5, the geography of natural change is quite similar to the one just described for total growth rate. The municipalities with the highest negative natural balances are mostly located in Liguria, Friuli-Venezia Giulia and Piemonte⁷. On the other hand, natural balances are generally positive in the province of Bolzano/Bozen, with peaks in Naz-Sciaves/Natz-Schabs (97.4), Vadena/Pfatten (76.1), Terento/Terenten (73.5) and Velturno/Feldthurns (69.9). A remarkably positive natural balance (89.1) is also found in Livigno, in the province of Sondrio.

Figure 1.5. Natural balance in the municipalities of the Italian Alps, 2014-2023.



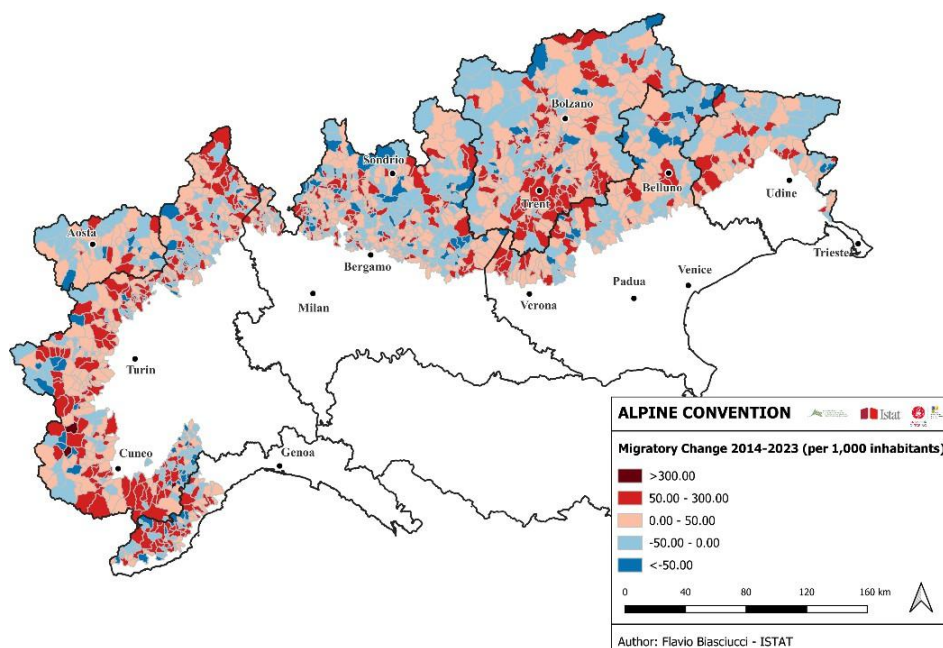
⁷ The municipality that shows the highest level of negative natural balance is Sala Comacina (-437.7), in the province of Novara, followed by several other municipalities in the Piedmontese Alps, notably Noaschia (-391.0), in the province of Turin, and two municipalities both belonging to the province of Cuneo, Pamparato (-311.5) and Roaschia (-309.7).

Moving from natural balance to net migration, Figure 1.6 confirms what Tables 1.3 and 1.4. had already indicated, namely that in the 2014-2023 decade net migration has been overall positive (+20.73 per 1000 inhabitants) and that in the municipalities with altitude > 700 m and medium-high degree of urbanisation the migration balance reaches the value of +37.85 per 1000 inhabitants⁸. Again, these seem potentially highly important findings, which definitely deserve further investigation.

Migration has of course affected the Alpine territory in different ways and to different degrees (the municipalities with higher migration balances are generally located in peri-Alpine areas and in the Central Alps, mainly in the province of Trento) and has consequently shaped a complex and fragmented demographic landscape. The mixed effects of the natural and migratory components of total population change may result in different values and signs and, most of all, may have completely different impacts on the characteristics of the resident population and on the facilities and policies to implement or support.

What is beyond doubt, however, is that the demographic evolution of the Italian Alps has been strongly influenced by migratory flows, which have partly offset the loss of population due to the negative natural balance and in particular to the decrease in fertility rates (mortality being fairly stationary over the decade) generating significant rates of population turnover. Migration thus deserves to be looked at in greater detail.

Figure 1.6. Migration balance in the municipalities of the Italian Alps, 2014-2023.



⁸ At the municipal level, the highest positive migration balances can be seen in municipalities in the province of Cuneo such as Battifollo (+450.5), Stroppo (+361.9) and Oncino (+312.5). Moncenisio, in the province of Turin, also shows a notably positive migration balance (+333.3). On the opposite side, Montezemolo (CN) is the municipality with the highest negative migration balance (-300.6 per 1000 inhabitants), followed by another municipality in the province of Cuneo, Castelnuovo di Ceva (-233.5), and by Cavargna (-203.5), in the province of Como, and Foppolo (-200.6), in the province of Bergamo.

2. Residential mobility to and from Italian Alpine municipalities

Marco Battaglini, Francesca Licari (coordination), Daniela Mariana Yáñez, Andrea Membretti, Sara Miccoli, Viktoriia Tomnyuk

2.1 Across peaks and borders: internal and international migration in the Italian Alps

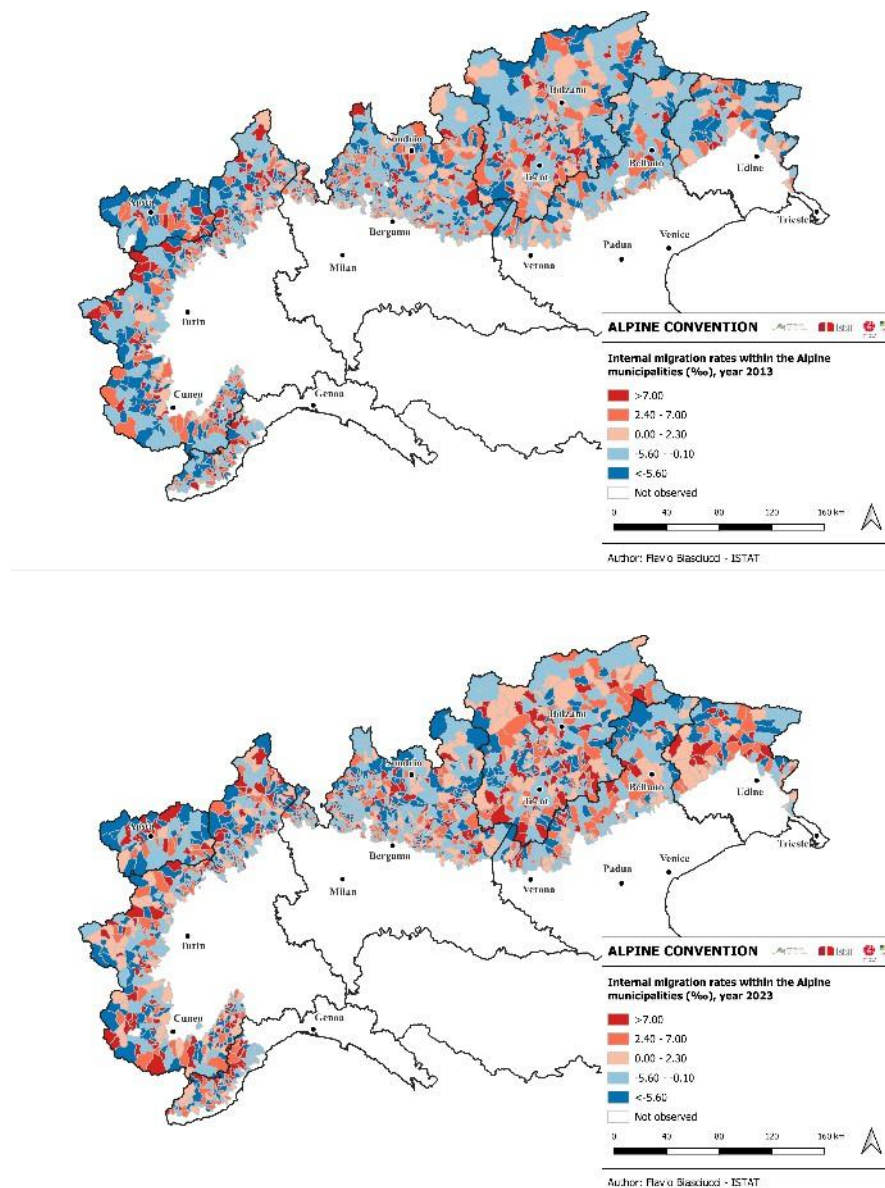
The Alpine region is characterised by its unique topography and socioeconomic diversity, offering a distinctive perspective on contemporary migration patterns. Historically shaped by internal mobility and transnational flows mostly involving neighboring countries, new demographic issues related to population movements across administrative, linguistic and national borders are being faced by the Italian Alpine areas today.

An initial overview of migration flows, as well of any changes that have occurred over time, is provided by an analysis that distinguishes internal migration (within national borders) from international migration (with foreign countries) and pays special attention to migratory movements between Alpine municipalities on the one hand and with non-Alpine municipalities on the other.

In 2023, just over half of Italian Alpine municipalities show a positive internal migration rate with other Italian Alpine municipalities (corresponding to the red colors in Figure 2.1). Thus, in about half of the municipalities, the number of immigrants from other Alpine municipalities exceeds the number of emigrants to other Alpine municipalities. In 2013, the share of municipalities with positive internal migration was slightly lower, at just under 50%. Therefore, over the decade, the internal dynamics involving Alpine municipalities appear to have changed slightly, with a substantial balance between Alpine municipalities attracting population from other Alpine municipalities and municipalities losing residents to other municipalities in the Alpine arc.

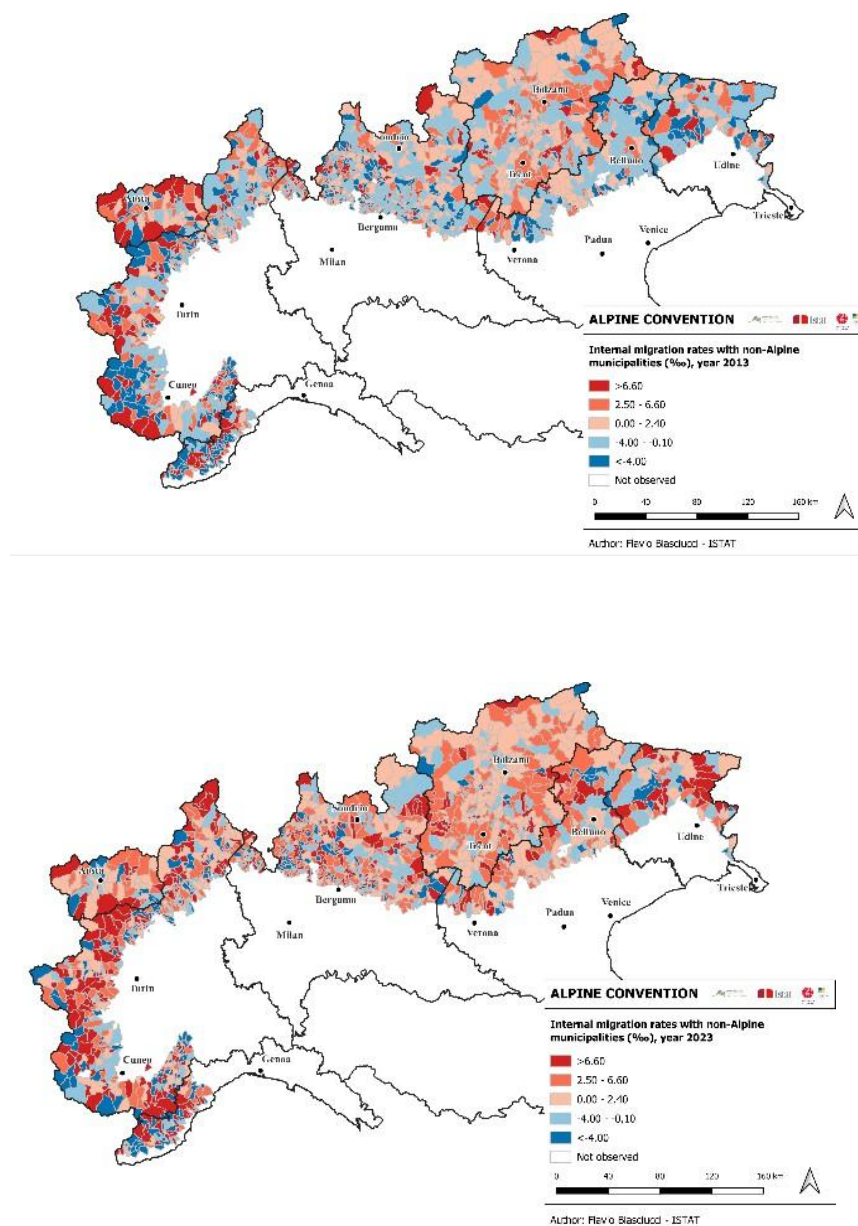
The data therefore seems to indicate a fluid situation of intra-Alpine residential mobility, which will deserve further attention in the near future.

Figure 2.1. Internal migration rates between the Alpine municipalities. Years 2013 and 2023. Values per thousand inhabitants.



However, more significant changes can be observed when analysing the internal migration rates of Alpine municipalities with non-Alpine municipalities. In 2023, just over 70% of Alpine municipalities record a positive internal migration rate (red colors in Figure 2.2), meaning that the number of immigrants from municipalities outside the Alpine arc exceeds the number of emigrants moving to non-Alpine municipalities. Ten years earlier, the proportion of municipalities with a positive internal migration rate with non-Alpine municipalities was lower, at just over 55%. Therefore, in ten years, the number of Alpine municipalities able to attract population from municipalities outside the Alpine region has increased.

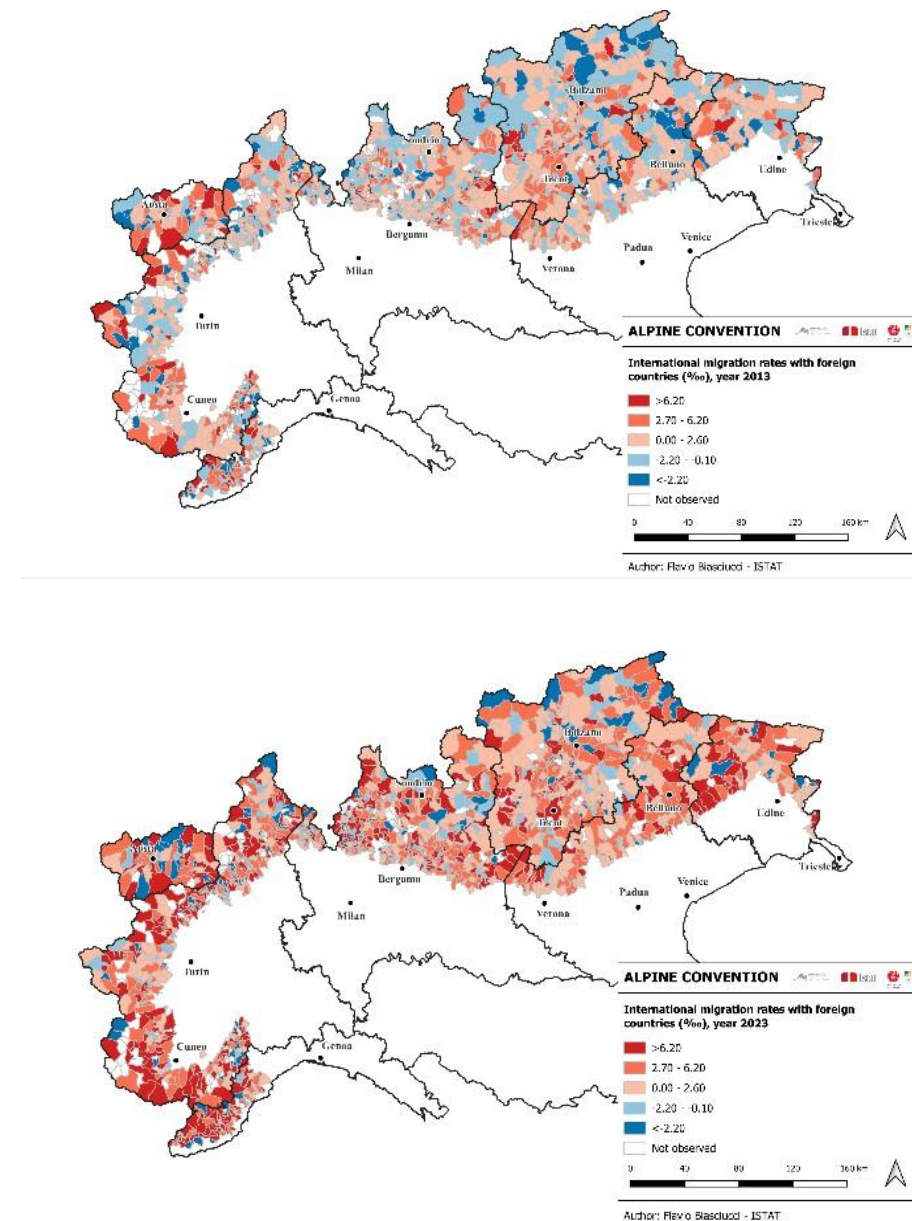
Figure. 2.2. Internal migration rates with non-Alpine municipalities. Years 2013 and 2023. Values per thousand inhabitants.



Alpine municipalities appear to be also increasingly attractive to people coming from foreign countries. Indeed, the proportion of Alpine municipalities with positive international migration rate (municipalities in red colors in Figure 2.3) is about 84% in 2023, compared to 74% in 2013. This points to a different distribution among municipalities, which deserves further investigation in the future.

In most Alpine municipalities, the number of immigrants from foreign countries is therefore higher than the number of emigrants toward foreign countries, and the number of municipalities with positive international migration rates increased over the decade. Most Alpine municipalities have thus experienced an increase in their attractiveness over the last ten years and this is particularly true with regard to migration to non-Alpine municipalities and foreign countries.

Figure 2.3. International migration rates with foreign countries. Years 2013 and 2023. Values per thousand inhabitants.



2.2. Migration patterns of Italian Alpine municipalities

The analysis of the origin/destination matrix between the different territorial typologies⁹, distinguished by altitude (below and above 700 meters above sea level), in the years 2013 and 2023, reveals interesting population redistribution dynamics, and allows for a deeper understanding of internal and international migration patterns.

⁹ As in Chapter 1 above, the international classification DEGURBA (Degree of Urbanisation) was used to analyse the migratory movements of Alpine municipalities.

As emerged from the analysis of the maps, some areas have increased in attractiveness during this period, while others have experienced intensified outmigration. Notably, Alpine municipalities – particularly if they are well connected and located at a lower altitude – have become more attractive than other areas of the country, and the observed dynamics seem to favor population redistribution from larger urban centers to smaller centers and rural areas. Furthermore, international migration flows represent an increasingly important component, having the capacity to counteract internal dynamics to some extent.

More specifically, the internal migration balance of Alpine cities¹⁰ was slightly positive in 2013 (+109), mainly due to inflows from rural areas (Table 2.1). By 2023, however, the situation had reversed sharply, with a negative internal balance of -666 due to outflows to Alpine small towns and rural areas. The attractiveness of Alpine towns compared to non-Alpine municipalities is also decreasing (from +1,601 to -238): these data deserve further investigation in the future, also in relation to the analyses conducted in the recent 9th Report on the State of the Alps, devoted to Alpine Towns.

However, the increase in attractiveness compared to foreign countries is significant, with a migration balance rising from +1,085 to +1,529. This mitigates the net loss of population due to internal mobility.

Table 2.1. Internal and international migration flows in the Alpine municipalities. Years 2013 and 2023

2013	Alpine municipalities						Other Italian municipalities	Abroad
	Cities	Towns ≤700 m	Towns >700 m	Rural ar- eas ≤700 m	Rural ar- eas >700 m	Total		
Cities	0	-84	30	42	121	109	1,061	1,085
Towns ≤700 m	84	0	114	910	770	1,878	3,092	4,156
Towns >700 m	-30	-114	0	-3	144	-3	215	10
Rural areas ≤700 m	-42	-910	3	0	229	-720	-420	1,398
Rural areas >700 m	-121	-770	-144	-229	0	-1,264	-315	623
Total	-109	-1,878	3	720	1,264			

¹⁰ Only low-altitude cities below 700 meters above sea level are observed.

2023	Alpine municipalities						Other Italian municipalities	Abroad
	Cities	Towns ≤700 m	Towns >700 m	Rural areas ≤700 m	Rural areas >700 m	Total		
Cities	0	-445	28	-161	-88	-666	-238	1,529
Towns ≤700 m	445	0	-12	215	584	1,232	6,216	9,963
Towns >700 m	-28	12	0	25	-10	-1	143	196
Rural areas ≤700 m	161	-215	-25	0	296	217	2,203	4,624
Rural areas >700 m	88	-584	10	-296	0	-782	1,095	2,114
Total	666	-1,232	1	-217	782			

Despite the decline in the migration balance between Alpine municipalities (from +1,878 in 2013 to +1,232 in 2023), small towns located at low altitudes (≤700 m) are the main pole of attraction. Conversely, there has been an increase in attractiveness towards both other Italian non-Alpine municipalities (from +3,092 to +6,216) and, more notably, foreign countries (from +4,156 to +9,963). Small lowland urban areas are perceived as places that strike a balance between urbanisation and high quality of life and are able to attract residents from all kinds of areas. On the other hand, high-altitude small towns show almost stable mobility between Alpine municipalities over the decades (from -3 in 2013 to -1 in 2023). However, their attractiveness with respect to non-Alpine municipalities is decreasing (from +215 to +143), while a significant improvement is observed in the balance with foreign countries (from +10 to +196). The issue of altitude deserves further investigation, also with regard to the various impacts of climate change in relation to the same.

In contrast to the previous ten years, rural areas at low altitudes (≤700 m) showed a strongly negative internal balance in 2013 (-720), mainly due to outflows to small towns at low altitude (-910). However, in 2023 these areas showed a positive internal balance (+217), thanks to a reduction in outflows and an increase in new inflows, particularly from cities and rural mountain areas. This is indicative of growing attractiveness, which is probably linked to new forms of residency (e.g. smart working and a return to green areas). This attractiveness has increased significantly in comparison with non-Alpine municipalities (from -420 to +2,203) and, above all, foreign countries (from +1,398 to +4,624).

Conversely, rural areas at high altitudes (>700 m) are affected by mobility between Alpine municipalities, with negative migration balances (-1,264 to -782), although these are improving. However, they manage to offset their net losses and slow down depopulation in the medium term, thanks to positive net mobility with non-Alpine municipalities (+1,095) and foreign countries (+2,114).

Thus, the decade from 2013 to 2023 has seen a repositioning of migration geography, with small, low-altitude urban centers becoming more and more attractive and mobility increasing due to factors such as quality of life, accessibility, and new housing models.

2.3 The role of international migration

In the period between 2013 and 2023, the international migration balance with foreign countries shows for Italian Alpine municipalities a significant increase, rising from a positive balance of 7,272 to 18,425 (table 2.2). This growth is entirely driven by foreign immigrants, whose balance rose from +11,853 to

+23,646 over the period. In contrast, international migration balance for Italian citizens remains negative and has indeed slightly worsened, going from -4,581 to -5,221. These figures confirm that the nation-wide pattern is detectable also in the Alpine municipalities: a continued loss of Italian residents towards foreign countries is offset by sustained immigration from abroad.

Table 2.2. Migration balance with foreign countries of Italian Alpine municipalities, by neighboring countries and geographical areas – Years 2013 and 2023

Country/Area	2013				Total balance	2023		
	<i>Total balance</i>	<i>of which Italians</i>	<i>of which foreigners</i>	<i>of which aged 25–34</i>		<i>of which Italians</i>	<i>of which foreigners</i>	<i>of which aged 25–34</i>
<i>Austria</i>	-512	-507	-5	-304	-711	-734	23	-473
<i>France</i>	-487	-459	-28	-145	-536	-534	-2	-167
<i>Switzerland</i>	-945	-905	-40	-351	-1,119	-1,086	-33	-561
<i>Slovenia</i>	6	-13	19	10	75	-1	76	21
Total neighbouring countries	-1,938	-1,884	-54	-790	-2,291	-2,355	64	-1,180
Other EU countries	1,726	-1,060	2,786	308	-506	-2,195	1,689	-720
Other non-EU countries	2,002	-832	2,834	364	5,913	-752	6,665	1,052
EUROPE	1,790	-3,776	5,566	-118	3,116	-5,302	8,418	-848
ASIA	2,006	-179	2,185	670	4,800	-89	4,889	1,678
AFRICA	3,101	-48	3,149	1,079	6,162	115	6,047	1,842
North America	126	-265	391	-3	474	-148	622	14
Latin America	314	-225	539	98	4,003	354	3,649	1,182
AMERICA	440	-490	930	95	4,477	206	4,271	1,196
OCEANIA	-65	-88	23	-52	-130	-151	21	-123
TOTAL	7,272	-4,581	11,853	1,674	18,425	-5,221	23,646	3,745

Looking in detail at flows with neighboring Alpine countries (Austria, France, Switzerland, and Slovenia) the balance remains negative and has actually worsened from -1,938 to -2,291. In particular, losses increased towards Switzerland (from -945 to -1,119) and Austria (from -512 to -711), while the balance with Slovenia improved slightly (from +6 to +75). It is important to note that migration

balance of young people aged 25–34 towards these neighboring countries stayed negative and increased from -790 to -1,180. This shows that these nearby foreign countries keep attracting young Italian residents. In contrast, the trend with other EU countries (excluding neighbors) changed: in 2013 the balance was positive (+1,726), but in 2023 it turned negative (-506). This suggests a lower ability of Alpine municipalities to attract citizens from the EU or, alternatively, that more Italians chose to move to other EU countries.

The balance with other non-EU countries increased strongly: from +2,002 to +5,913. Positive flows from Asia rose from +2,006 to +4,800, and the same is true for Africa, from +3,101 to +6,162. Latin America saw a big increase too, from +314 to +4,003, while North America grew more modestly from +126 to +474. All these increases are mainly due to foreigners, thus confirming that international migration is the main factor accounting for the positive balance.

As far as international migration is concerned, the positive migration balance displayed by the Italian Alpine municipalities over the past ten years is almost entirely due to foreign immigration, which more than offsets the constant loss of Italian residents. The migration balance of young people aged 25–34 also increased overall (from +1,674 to +3,745), but the losses towards neighboring countries remain worrying, since they reveal a continuing outflow of young people to nearby areas.

Therefore, the resulting picture is one of Alpine regions becoming more international and multicultural, able to attract new population from Africa, Asia, and Latin America, but still struggling to keep their own young people and, more generally, Italian residents, who continue to emigrate mainly to nearby European Alpine countries.

More generally, however, if we take both internal and international migration into account, the data provided by the first chapter and the figures added by this second chapter show that between 2013 and 2023 in the Italian Alpine area as a whole net migration has been positive, although both trends and especially levels may differ substantially from one region to another, and of course even more markedly between municipalities and, indeed, within the boundaries of single municipalities.

3. New indicators on climate change, fragility and accessibility in Italian Alpine municipalities

Filippo Barbera, Flavio Biasciucci, Livia Fay Lucianetti, Daniela Mariana Yáñez, Anna Emilia Martino, Andrea Membretti (coordination), Tiziana Tamburrano

3.1 Introduction

Population movements, residency and the potential attractiveness of mountain areas – or even repulsiveness – are increasingly influenced by climatic factors, in relation to current and future changes which already have an impact on the territories.

With the aim of depicting relevant risks factors for the people who already live in the Italian Alpine municipalities, or may move to live there in the future, this chapter presents a selection of innovative indicators related to climate change and environmental transformation, as well as indicators of social and territorial fragility.

To exemplify how the links between these social and environmental indicators may be analysed in greater depth in a specific case study, a focus on the Aosta Valley region is also presented¹¹.

The maps and the related indicators here described are based on quintiles generated by the cartographic software that has been used (QGis). Quintiles were calculated considering Italian Alpine municipalities only.

3.2 Census-based indicators of individual fragility

The whole territory of Italian Alpine municipalities is an area subject to multiple risks as a result of several factors: on the one hand, demographic changes (ageing of local population, outmigration, etc.), and on the other hand, severe climate changes that have a major impact on these areas (hydrogeological instability, fires, extreme events, landslides, etc.). We can address these challenges through a greater and deeper understanding of the territory, capturing local differences and identifying old and new risk factors for the populations living there.

The indicators chosen here are functional to identify specific components of the Alpine population that, in case of extreme events and severe climate threats, may have greater difficulty in getting to safety than the rest of the population. Categories of inhabitants who, in any case, may feel more insecure in the area, with the consequence of a greater propensity to leave mountain areas for the more populated valley floors or plains.

These indicators are: Percentage incidence of the population aged 75 and over living alone (and therefore finding it more difficult to obtain support from other family members when needed); Percentage incidence of households¹² in which no member owns a car (and therefore depend on public transport, which is often lacking in mountainous areas, as they do not have their own means of transport to leave).

¹¹ This case study was chosen because it is an entirely mountainous area, at high risk of hydrogeological instability (it is the area at highest risk in the Italian Alps) and suffering from strong demographic decline. At the same time, some localities of the regions show an increasing attractiveness to new residents from big cities in the plains, like Milano and Torino, as already shown by MICLIMI research project (www.miclimi.it).

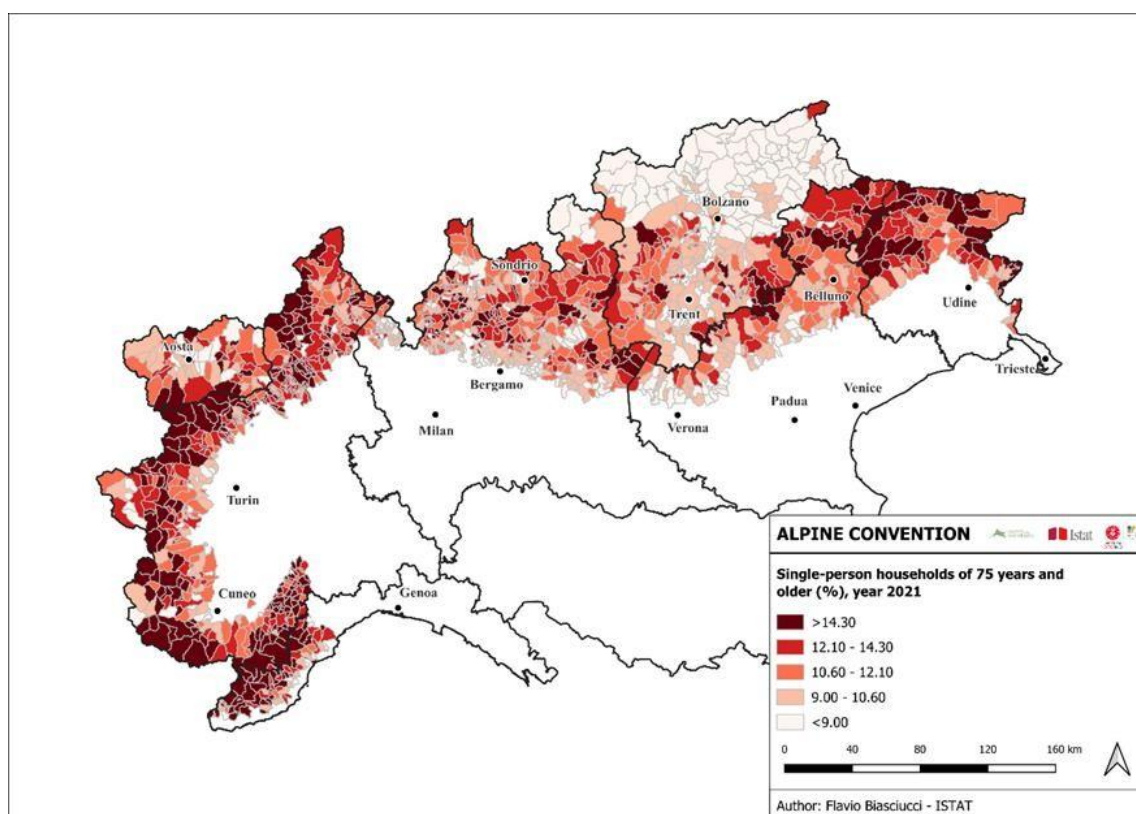
¹² The definition of “household” here adopted is the following: “A group of people linked by marriage, civil partnership, kinship, affinity, adoption, guardianship, or emotional ties, cohabiting and habitually residing in the same municipality (even if they are not yet registered in the municipal register of residents). A household may also consist of a single person. Persons who are temporarily absent do not cease to belong to their household, whether they are staying at another residence (or cohabiting) in the same municipality, in another Italian municipality or abroad”.

the area in case of emergency); Percentage incidence of households living in sections of scattered houses (and therefore, isolated dwellings, where in case of difficulty there are no other inhabitants nearby).

The indicators above mentioned represent an innovative element with respect to the study of potential risk factors in mountain contexts, and it is also possible to refer them to a sub-municipal level, identifying with even greater precision the micro-areas where the most exposed population is located. Such information could be useful to better target available resources in both prevention and emergency management: for example, by assessing the need to evacuate residents from a certain area, or to prevent new settlements from being established in places where the risk conditions are excessive, instead encouraging people to remain or settle in safer places.

The first indicator we will consider is that of the Incidence of the population aged 75 and over living alone in mountain areas: this turns out to be highest in the Alpine municipalities of Liguria, Piemonte, and Friuli Venezia-Giulia, especially in the border areas, while Trentino and Alto-Adige/Südtirol are the regional areas with the lowest incidence (Fig. 3.1)¹³.

Figure 3.1: Incidence of the population aged 75 and over living alone in mountain areas

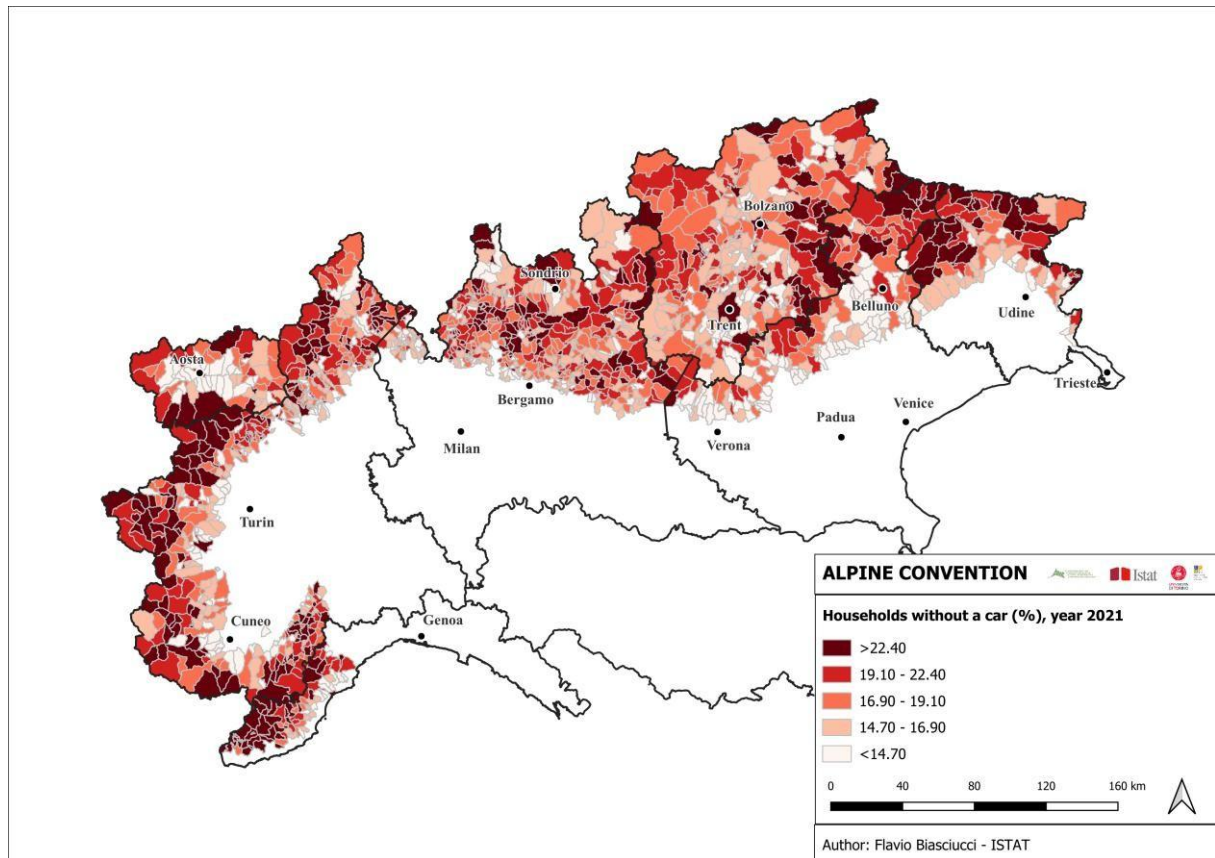


As for the Percentage Incidence of households in which no member owns a car, Figure 3.2 shows areas of concentration of higher values again in the municipalities located in Liguria, Friuli-Venezia Giulia and Piemonte, particularly those bordering on Aosta Valley, as well as municipalities bordering on Trentino Alto-Adige/Südtirol and Veneto¹⁴.

¹³ In particular, the municipalities with the highest incidence of elderly people living alone are Drenchia (UD) with 37.5%, Ribordone (TO) with 29.5%, and Torresina (CN) with 29.2%. In contrast, the municipalities of Trezzone (CO) and Blello (BG) have the lowest values, 2.9% and 3%, respectively.

¹⁴ Noteworthy municipalities are Campione d'Italia (CO) and Morterone (LC) in Lombardia with 69.9% and 45% and Gurro (VB) and Ribordone (TO) in Piemonte with 46.5% and 45.5%.

Figure 3.2. Percentage of households without a car

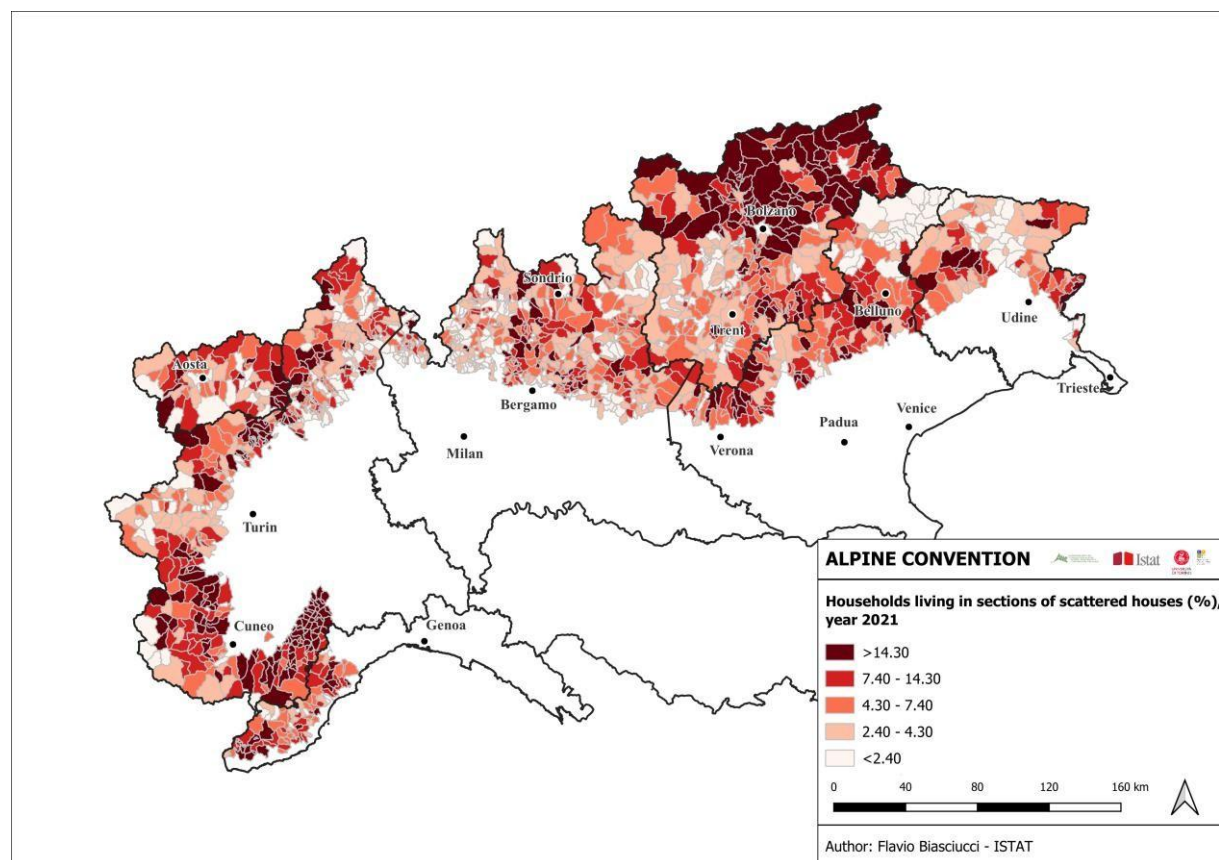


With respect to the Percentage Incidence of Households Living in Sections of Scattered Houses, the highest values of the indicator are observed throughout South Tyrol (region in which scattered and isolated settlements, such as farmsteads, have historically been significant), and in municipalities in Piemonte bordering on Liguria and Valle d'Aosta (Fig. 3.3)¹⁵.

The data presented so far show relevant Italian Alpine areas where elderly people live alone, often in isolated homes and without a car: this highlights the presence of a significant number of mountain areas exposed to climate and environmental risks – and in general to risks due to social isolation, such as health or psychological risks – especially in the western Alps.

¹⁵ It is the municipalities of Levice, Perletto, and Bonvicino in the province of Cuneo and the municipality of Laregno in the province of Bolzano that have the highest incidence of households living in scattered houses, with values of 82.9%, 78.9%, 71.4%, and 76.1%, respectively.

Figure 3.3. Percentage of households living in sections of scattered houses



3.3. Municipal fragility

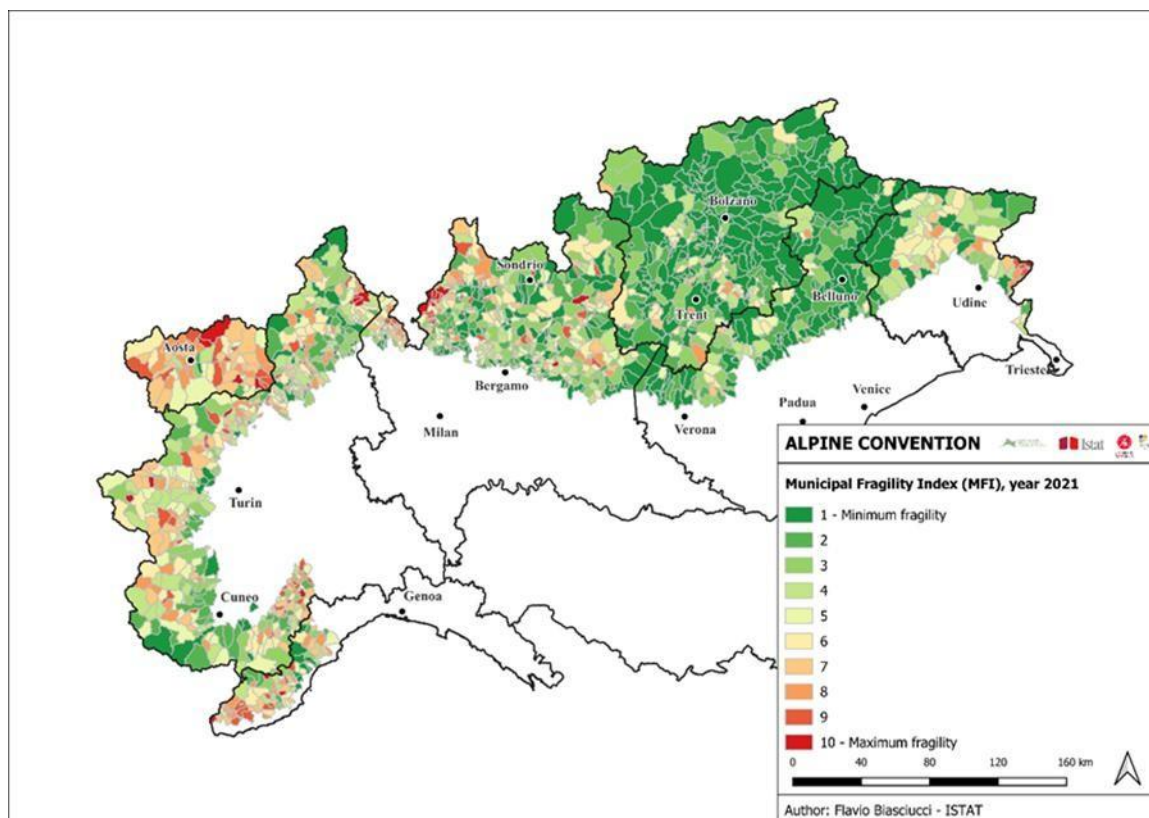
Another innovative tool to better understand the socio-environmental complexity of mountain territories is represented by the Municipal Fragility Index¹⁶: this index indicates the level of fragility of a municipality, implying the exposure of a territory to risks of natural and anthropic origin and to critical conditions linked to the main socio-demographic characteristics of the resident population and of the economic-productive system.

The index presents a great variability among the municipalities belonging to the Alpine Convention (Figure 3.4). On the one hand, the municipalities of Trentino-Alto Adige/Südtirol, Veneto, the northern part of Friuli-Venezia Giulia, the north-eastern and central areas of Lombardy, and the southern municipalities of Piemonte bordering on France, have low values of the index, showing least fragility in the territorial, environmental and socio-economic dimensions; on the other hand, mountain areas such, first of all, Aosta Valley, and then western Liguria, various areas of Piemonte and Lombardy, as also municipalities of Friuli Venezia-Giulia bordering on Slovenia, are characterized by higher values of the index, demonstrating a weaker and more fragile municipal system, due to the combination of socio-economic and environmental factors.

¹⁶ The fragility index has been developed by ISTAT and the latest update can be found at the following link: <https://www.istat.it/comunicato-stampa/aggiornato-indice-di-fragilita-comunale/>, while the methodological note can be found here: https://www.istat.it/wp-content/uploads/2024/07/IFC_Nota-metodologica.pdf

In general, also in this case, the western Alpine regions appear to be more fragile overall, particularly when this fragility is combined with the demographic variables considered above, linked to ageing and isolation.

Figure 3.4. Municipal Fragility Index



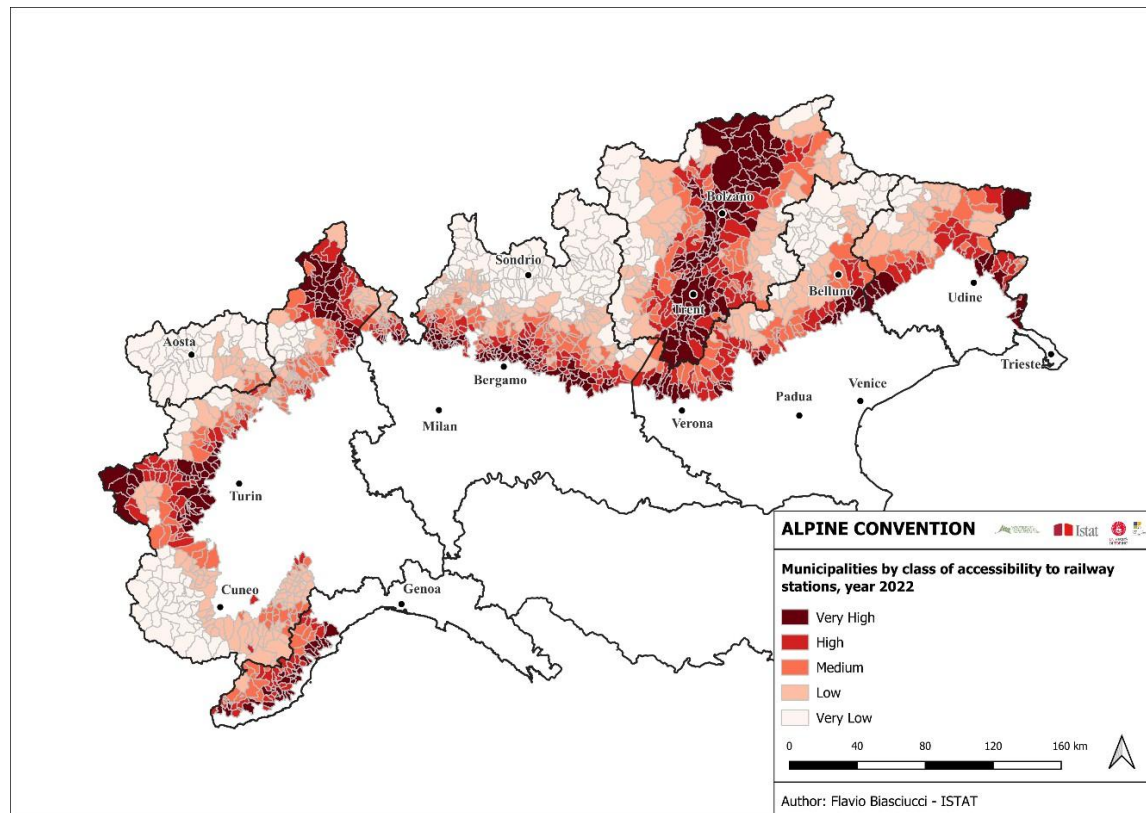
3.4 Accessibility of Italian Alpine municipalities

The safety of mountain areas for those who live there or visit them, their actual habitability, and the ability to deal with the risks associated with climate and environmental change are also related to the level of accessibility of the areas themselves, i.e., the issue of mobility.

Accessibility indexes show a wide range of values across the Italian Alpine arc. In particular, accessibility to train stations, that takes into account the quality of the services provided¹⁷, varies considerably in the Alpine municipalities of different regions. In general, in the Alpine area accessibility to train stations is quite low compared to the rest of the country. The Alpine municipalities showing the highest levels of accessibility are located in particular in the autonomous provinces of Bolzano/Bozen and Trento (where high-speed rail services are present), in the foothills near the Po Valley (where some rail connections directly arrive from urban hubs), along the Piemonte axis connecting Italy and France and in the international railway corridor connecting Lombardy to Switzerland. Beyond these specific areas, access to railway stations appears to be limited or, in many cases, non-existent.

¹⁷ The description of the methodology used is available on ISTAT website: <https://www.istat.it/en/press-release/accessibility-of-municipalities-to-major-transport-infrastructures/>

Figure 3.5. Municipalities by class of accessibility to railway stations



On the other side, a relevant portion of the Italian Alpine municipalities is instead well connected to highways. In 2024, 57.4% of Italian Alpine population lives in municipalities with a high or very high accessibility to highways, while 17.4% lives in medium accessibility municipalities and 25.1% lives in low or very low accessibility municipalities. It should be noted that some areas, such as Trentino-Alto Adige/Südtirol, are very well connected by both train and motorway, while others are extremely poor in both connections.

Very low levels of highway accessibility characterize in particular most Alpine municipalities in southern Piemonte (Cuneo province), Valle d'Aosta/Vallée d'Aoste and Lombardia. The problem is particularly severe in the province of Sondrio, where the entire Alpine population is poorly connected to highways, but also in the provinces of Lecco and Como, with respectively 89.9% and 68.4% of the Alpine population living under the same conditions.

Figure 3.6. Municipalities by class of accessibility to the highway network

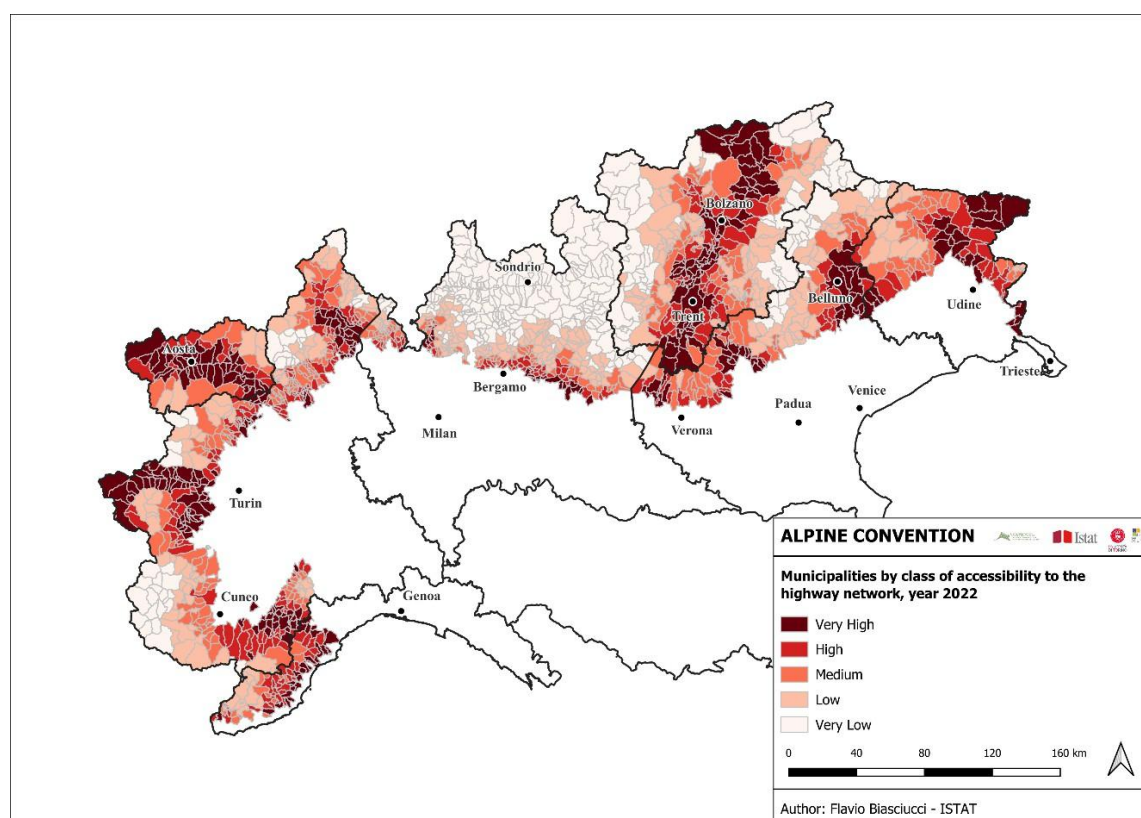
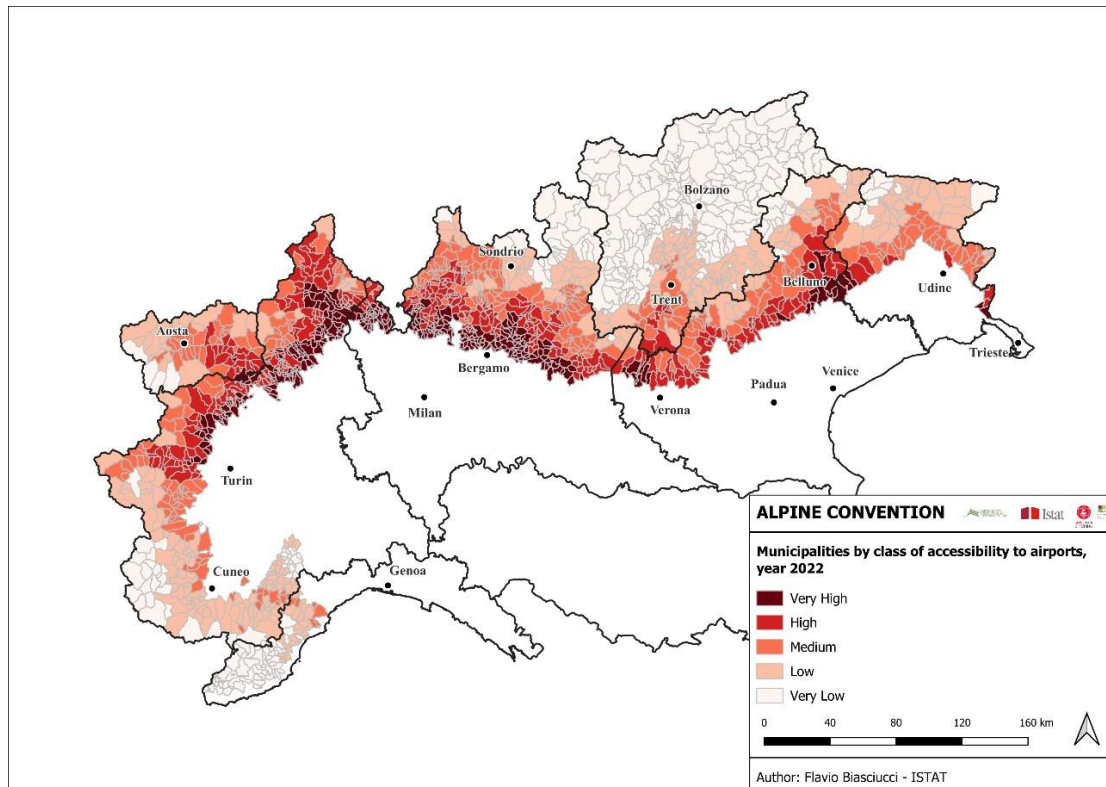


Table 3.1 Population living in Italian Alpine municipalities by level of accessibility to the highway network (quintiles) and region. Year 2024.

REGIONS	Accessibility to the highway network					Total
	very high	high	medium	low	very low	
Friuli-Venezia Giulia	106,303	53,749	37,810	4,209	1,313	203,384
Lombardia	125,194	238,853	225,604	344,959	327,441	1,262,051
Piemonte	340,203	272,716	180,397	50,525	7,277	851,118
Trentino-Alto Adige/Südtirol	544,494	213,689	123,113	95,977	105,429	1,082,702
Bolzano/Bozen	259,785	114,384	62,108	34,259	66,997	537,533
Trento	284,709	99,305	61,005	61,718	38,432	545,169
Valle d'Aosta/Vallée d'Aoste	106,692	7,746	5,760	2,679	-	122,877
Veneto	236,708	159,400	171,489	110,320	30,445	708,362
Total	1,512,908	963,428	751,542	612,044	471,905	4,311,827

Shifting the focus to air mobility, it can be noticed that the Alpine population better connected to airports is the one that is closest to metropolitan areas such as Milano, Torino, Venezia, where international airports are located. Very low levels of accessibility to airports characterize instead the autonomous province of Bolzano/Bozen (that however, across the international border, can count on Austrian and German airport hubs), part of the province of Cuneo (Piemonte) and western Liguria.

Figure 3.7. Municipalities by class of accessibility to airports



3.5 Valle d'Aosta/Vallée d'Aoste Focus

With the aim of analysing some of the dynamics described above in greater depth, it was therefore decided to focus research on the Valle d'Aosta/Vallée d'Aoste region, given its peculiarity with respect to certain forms of socio-environmental fragility.

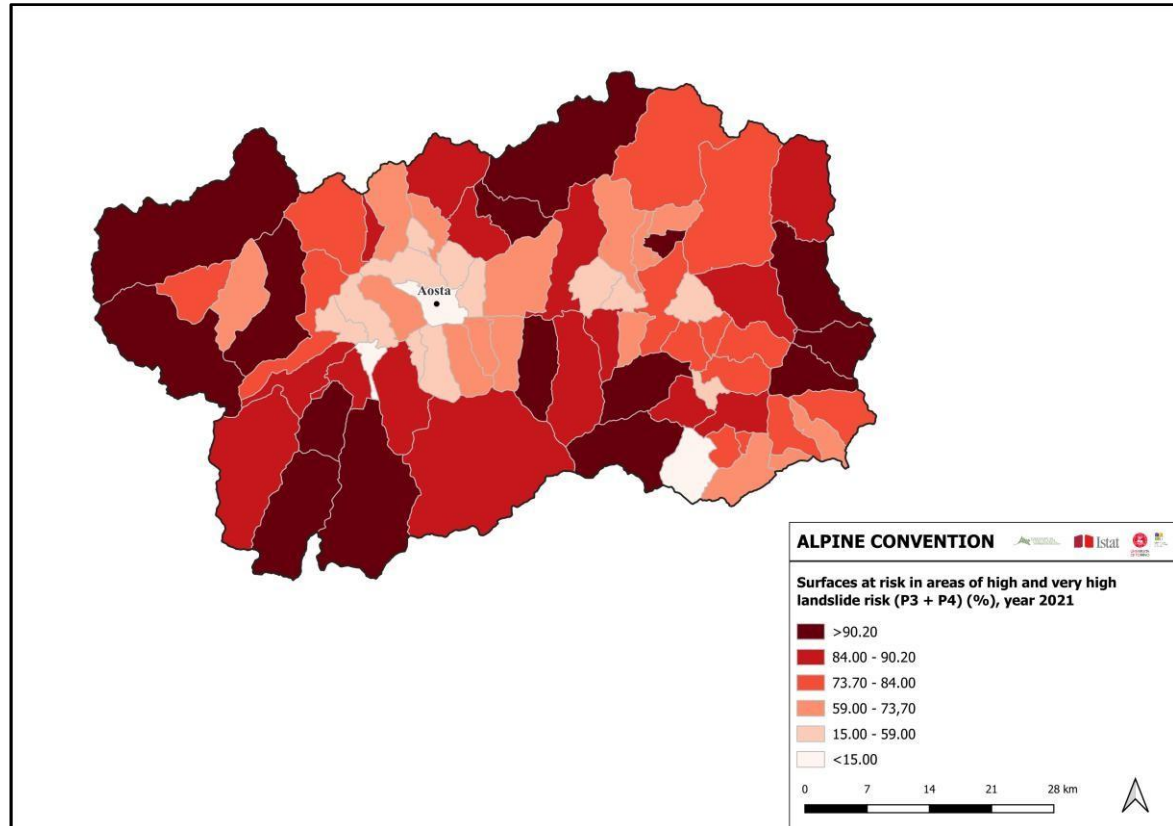
The autonomous region of Valle d'Aosta/Vallée d'Aoste is a highly diversified territory in geological and geographical terms. The area comprises 74 municipalities with different altitudes and degrees of urbanisation. The combination of these two characteristics provides a better understanding of availability and access to basic services, and of the unique geographical features, which can have a direct impact on the environmental risks. A matrix¹⁸ was here developed to classify each municipality into rural-high-land, intermediate-highland, rural-lowland, and intermediate-lowland categories.

If we look at the exposure to environmental and geological risks, we find (Figures 3.8 and 3.9) that almost half of the municipalities (30 out of 74) of the Valley have over 84% of their surface at risk, as located in areas of high and very high landslide risk (P3+P4 levels), even though in many cases these are rural municipalities in inland areas with very small populations (with the exception of a few major tourist destinations). On the contrary, the most populated area surrounding the capital city of Aosta/Aoste (located in a large flat area at the bottom of the valley, which is in fact called *Plaine d'Aoste*), together with two other municipalities, have less than 15% of surfaces at risk (P3+P4).

Considering the people living in the autonomous region, the 12 municipalities surrounding Aosta/Aoste are again the ones at lowest landslide risk, with less than 15% of households residing in areas of high and very high landslide risk (P3+P4).

On the other hand, 28 municipalities have a range from 20.3% to 50.3% of households are at risk, highlighting how the risk of exposure to landslides for the resident population is significant overall in the region, and in particular as soon as you leave the flat area of the valley floor around Aosta/Aoste.

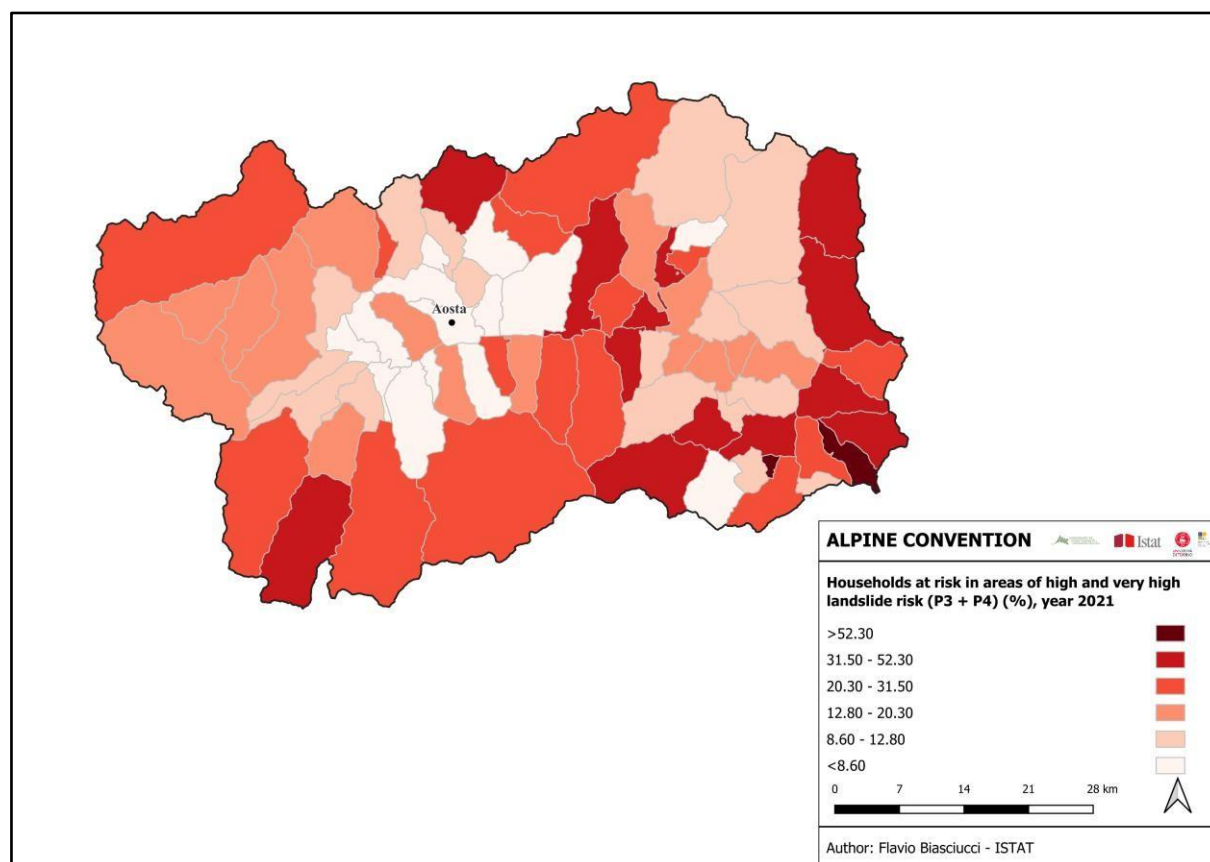
Figure3.8. Valle d'Aosta/Vallée d'Aoste: Surfaces at risk in areas of high and very high landslide risk



Source: ISPRA (2020) Danger and risk indicators on landslides and floods.

¹⁸ The matrix is the combination of two factors: degree of urbanisation (DEGURBA) and altitude classification. The first refers to the classification of municipalities based on the criterion of geographical contiguity and minimum density and population thresholds of the regular grid with 1 km² cells. The categories are cities or highly populated areas, small cities or intermediately populated, and rural or area scarcely populated. The latter is the altitude above sea level of the town center. For the purpose of this report, highlands are territories above 599 meters above sea level while areas below this altitude are considered lowlands. For more details see: <https://www.istat.it/classificazione/principali-statistiche-geografiche-sui-comuni/>.

Figure 3.9. Valle d'Aosta/Vallée d'Aoste: households at risk in areas of high and very high landslide risk



Source: ISPRA (2020) *Danger and risk indicators on landslides and floods*

It is worth remembering here that, recalling the Municipal Fragility Index (presented above in this chapter), Valle d'Aosta/Vallée d'Aoste is one of the most fragile regions in the entire Italian Alpine arc, with most of the municipalities having a value of the index between 6 and 10 (cf. Figure 3.4).

In considering various factors contributing to the fragility of mountain areas, climate change is definitely at the top of the list. The Alps are regarded as one of Europe's main climate change hotspots. Therefore, Valle d'Aosta/Vallée d'Aoste is not immune to the consequences of this phenomenon.

A closer look at key climate-related indicators reveals not only the heterogeneity of the area, but also potential risks for its population. Major differences between highlands and lowlands regarding changing rainfall patterns and winter temperatures in the last decades are shown in Table 3.2, with specific attention to the categorization of territories based on a combination of their altitude and degree of urbanisation¹⁹.

¹⁹ Definition of climate change indicators selected for this section:

Winter Temperature: Average winter temperature in °C - winter months: December (previous year), January, February - source: Copernicus - ERA5 monthly averaged data on single levels from 1940 to present.

Table 3.2. Valle d'Aosta/Vallée d'Aoste: extreme precipitations, dry days, frost days and winter temperature

	Extreme Precipitations						Dry Days					
	2003-2013			2014-2023			2003-2013			2014-2023		
	mean	min	max	mean	min	max	mean	min	max	mean	min	max
Aosta Valley	6.1	1	12	7.8	3	15	109.8	83	139	105.9	72.5	139.5
ALTITUDE-URBANIZATION												
1. Rural plain	6.1	3	11	8	3	13	110.9	83	130.5	106	79	130
2. Intermediate plain	6.1	3	11	8.1	4	13	111.1	83	130	105.4	79	127
3. Rural mountain	6.1	1	12	7.8	3	15	109.7	83	139	105.8	72.5	139.5
4. Intermediate mountain	6.1	3	11.5	7.5	4	12.5	107.6	86	128	106.7	80	130
	Frost Days						Winter Temperature					
	2003-2013			2014-2023			2003-2013			2014-2023		
	mean	min	max	mean	min	max	mean	min	max	mean	min	max
Aosta Valley	70.9	30	100	51.6	19	69	-13.2	-20.4	-1.2	-11.5	-17.9	-1.8
ALTITUDE-URBANIZATION												
1. Rural plain	68.8	30	100	48.0	19	69	-12	-17.3	-1.2	-10.3	-15.1	-1.8
2. Intermediate plain	69.3	30	100	48.6	19	69	-11.3	-17.3	-1.2	-9.6	-14.8	-1.8
3. Rural mountain	71.1	30	100	52.1	19	69	-13.5	-20.4	-1.3	-11.8	-17.9	-1.9
4. Intermediate mountain	74.0	44.5	100	56.6	24	69	-14.8	-17.3	-10.8	-13.1	-14.8	-11.3

Variations in precipitation have a direct impact on the agricultural sector, availability of water, and soil moisture. The latter is proving more and more significant for highlands as extreme precipitation days can increase the risk of landslides. In fact, in the period 2014-2024 the mean value has augmented from 6.1 days between 2003 and 2013 to 7.8 days.

Although changes in summer temperatures and annual heatwaves are not extremely significant in the period under consideration, it is possible to observe in the Valley a trend of rising temperatures given the diminished number of frost days per year. While between 2003 and 2013 it was possible to observe approximately 71 days with daily minimum temperature below 0°C, in the following decade, that number has drastically fallen to about 52, indicating increasingly warmer temperatures. Moreover, the average and minimum winter temperatures have increased by 1.7 and 2.5 °C, respectively.

Given the asymmetrically distributed consequences of climate change – also in relation to altitude and exposure of human settlements – these indicators have differential impacts, despite Valle d'Aosta being a relatively small region. Thus, in Table 3.2 a list of the most outstanding cases is provided, based on the selected indicators.

Frost days: Total days per year with daily minimum temperature below 0°C. Source: Copernicus - Climate indicators for Europe from 1940 to 2100 derived from reanalysis and climate projections.

Dry days: The longest period of consecutive days with daily precipitation below 1 mm in a year - Source: Copernicus - Climate indicators for Europe from 1940 to 2100 derived from reanalysis and climate projections.

Extreme precipitation days: The count of days per year with precipitation above the extreme precipitation threshold defined as the 95th percentile of total precipitation of rainy days over 1981-2010. Source: Copernicus - Climate indicators for Europe from 1940 to 2100 derived from reanalysis and climate projections.

Table 3.3. Valle d'Aosta/Vallée d'Aoste municipalities: extreme precipitations

OUTLIERS		2003-2013			2014-2023		
		Extreme Pricipitations					
		mean	min	max	mean	min	max
1. Amad, Bard, Donnas, Hône	3.	5.8	3	11	8.2	6	13
2. Pont-Saint-Martin							
Lillianes, Perloz, Pontboset							
3. Gaby, Gressoney-Saint-Jean		6.3	3.5	12	9.1	4.5	13.5
3. Fontainemore		6.1	3	12	8.9	5.5	12.5
		Dry Days					
1. Montjovet-Pontey*		112.8	83	130	104.3	83	127
2. Châtillon-Saint-Vincent							
3. Antey-Saint-André, Brusson, Challand-Saint-Anselme, Emarèse, La Magdeleine							
1. Verres, Issogne	3.	112.6	86.5	130	105.4	81	125
Challand-Saint-Victor, Issime							
1. Hône, Amad, Bard, Donnas							
2. Pont-Saint-Martin	3.	112.4	90	130	106.5	79	127
Lillianes, Perloz, Pontboset		109.9	86.5	128.5	104.2	74.5	124.5
3. Fontainemore							
1. Amad-Bard-Donnas-Hône		64.4	30	87	40.3	19	53
2. Pont-Saint-Martin							
3. Lillianes-Perloz-Pontboset							
		Winter Temperature					
3. Rhêmes-Notre-Dame		-13.8	-15.6	-10.7	-11.7	-13.2	-9.6
3. Valgrisenche		-13.8	15.7	-10.9	-11.8	-13.2	-9.8
3. La Salle, Morgex, Prè-Saint-Didier		-14.5	-16.8	-11.2	-12.6	-14.1	-11.1
3. Ollomont		-16	-18.6	-12.3	-14.2	-15.8	-12.6

Climate data for the Valle d'Aosta/Vallée d'Aoste therefore show that extreme precipitations have increased, frost days have decreased, and winter temperatures have fallen. The differences that can be observed between different altitudes, and to a certain extent between levels of urbanisation, will need to be evaluated in more detail by future research.

However, it seems clear that the climate changes currently underway are creating new risk factors and challenges for the local populations. If, on the one hand, it is imperative to manage the consequences of extreme events and prevent damage, one should not overlook the new opportunities for the habitability of the territory that may be linked, for example, to milder winters.

Overall, the use of innovative indicators such as those presented in this chapter allows us to lay the foundations for an integrated analysis of socio-demographic and climatic-environmental factors and their influence on the concrete possibilities of living in mountain areas. It will therefore be necessary to further develop this approach, including through additional local case studies, in order to promote the development of a broader set of indicators capable of capturing the different facets and interrelationships of the phenomena under consideration.

4. Migration trends and residential mobility in the Austrian and Italian Alps: a general overview and two regional case-studies

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4.1 An overview of migration balances in the Austrian²⁰ and Italian Alps

The data collection and research initiative here presented aims at completing, updating and selectively expanding the migration data collected at the municipal level during RSA 5, and to prepare and analyse the data in a larger number of research initiatives on a comparative, national or regional scale across the Alps. A first step in this direction has been through a preliminary comparison between the Italian and the Austrian Alps²¹.

As in Chapter 3, also in this chapter a general overview of migration balance in the Austrian and Italian Alps will be followed by two regional studies which compare especially interesting settings located on the two sides of the border between the two countries.

The first evaluation based on the RSA 5 scheme has confirmed the main trends identified ten years ago in the principles²². The majority of migration takes place within the Alpine region: approximately 60% in Austria and slightly more than half in Italy (Tab. 4.1).

Domestic migration seems to be generally increasing, while migration to and from other countries seems to some extent more volatile. However, the different effects of the refugee crisis since 2015 are interesting. While the volume of migration with other countries, especially Asian countries, has increased significantly in Austria, there has been a general decline in migration with other countries in Italy²³. This may also be related to differences in the registration of refugees, which still need to be verified. Apart from this, the main countries of origin (for Italy: SE Europe, Africa; for Austria: SE Europe, Germany) remain the same as already reported in RSA 5.

The migration balances for the Alpine regions in both Austria and Italy are positive, with most of migration gains coming from abroad. While concerning the Alpine area within Italy the majority of domestic migration cases is into the Alps, most migration within Austria is out of the Alps.

²⁰ Throughout this chapter, the term “Austrian Alps” indicates the Austrian territory within the perimeter of the Alpine Convention.

²¹ It is important to notice that at the moment the data for the Italian Alps in the previous chapters are not fully comparable with those provided in this chapter because of slight differences in the periodisation that has been adopted and that will be harmonised during the research.

²² By dividing the database into four time periods of five years each (Austria) or individual years (Italy), it has now been possible to analyse changes over time, unlike with RSA 5. The core data, i.e. data on migration cases, is available in Italy in a higher resolution, namely annually. However, Italy has so far only provided data on immigration to Alpine communities, so that a comparison between the Alpine region and the non-Alpine or at least circum-Alpine area (northern Italy) is not yet possible. In addition, data on population, other mobility and the economy (employees in the economic sectors and tourist arrivals and overnight stays) are not yet available, so that it is not yet possible to classify municipalities to explain migration processes or to establish links to the second framework topic of RSA 5, i.e. employment.

²³ The figures provided by Table 4.1 corroborate, however, some of the most interesting findings that have emerged from Chapter 2, in particular the growth of out-migration from the Italian Alps towards foreign countries.

Table 4.1. Migration balances in the Austrian and Italian Alps

Region	Time	Migration balance			In-migration from			Migration	Out-migration to		
		Total	Extra-Alpine	Abroad	Total	Extra-Alpine	Abroad	Inner-Alpine	Total	Extra-Alpine	Abroad
AT-Alps	2002-06	27375	-23249	50624	813689	145214	186870	481605	786314	168463	136246
	2007-11	7074	-29770	36844	859485	163202	189254	507029	852411	192972	152410
	2012-16	82625	-38036	120661	1036322	187963	284774	563585	953697	225999	164113
	2016-21	52891	-15461	68352	1001758	200204	240628	560926	948867	215665	172276
IT-Alps	2002-06	146205	27031	119174	727348	255100	138883	333365	581143	228069	19709
	2007-11	145370	18075	127295	769326	253660	163417	352249	623956	235585	36122
	2012-16	51325	18158	33167	714535	252400	99321	362814	663210	234242	66154
	2016-21	81224	37005	44219	770923	274748	122020	374155	689699	237743	77801

The highest migration gains in the Austrian Alps continue to be recorded in the 30 to 49 age group and in the 0 to 14 age group, i.e. in the migration of families. The Italian exception, as reported in RSA 5, with the strongest gains in the 15-29 age group, continues in the decade 2012-2021. The strong increase in this age group in Austria, especially in the period 2012-16, is probably due to the wave of refugees, which needs to be analysed in more detail. The migration of ‘best agers’ (50-74 years) described in RSA 5 for Austria led to small (compared to younger age groups) but significant migration gains after 2012.

Table 4.2. Average annual changes (%) of the resident population groups in the Austrian Alps²⁴

Socio-geographic groups	Migration balance in the Alpine area of Austria				Migration to the Alpine area of Austria			
	2002-06	2007-11	2012-16	2016-21	2002-06	2007-11	2012-16	2016-21
Total	1,7	0,4	4,9	3,1	49,2	51,6	61,3	58,2
Male	1,5	0,1	5,6	3,1	50,9	53,1	66,3	61,8
Female	1,8	0,8	4,2	3,1	47,6	50,1	56,6	54,7
Aged 0-14	5,2	2,9	8,8	4,7	49,6	50,3	61,2	55,9
Aged 15-29	2,0	-1,9	8,3	2,9	104,8	111,9	140,1	131,0
Aged 30-49	2,1	1,1	6,8	5,8	51,2	55,5	69,2	71,4
Aged 50-74	0,0	0,0	0,8	1,2	15,9	18,3	20,9	22,5
Aged 75+	-3,2	0,1	-0,2	-0,2	18,6	19,4	19,0	21,1
Domestic nationals	-1,4	-2,4	-1,8	-0,8	34,9	37,2	38,6	38,7
Foreign nationals	3,0	2,6	6,5	3,7	17,1	17,6	26,9	24,6

²⁴ It has not yet been possible to calculate this for Italy due to the lack of data on the population structure.

4.2 Regional study I: quantitative-qualitative approaches in the Ladin valleys (IT) and in the Inn valley (AT)

The regional study I²⁵ aims to quantitatively describe and analyse migration patterns in the Ladin communities of the provinces of Bolzano/Bozen, Trento and Belluno, in Italy. In addition, the causes and effects of migration will be examined based on interviews with stakeholders, immigrants to and emigrants from the communities.

The Ladin region is a prototypical example of how the Alpine-wide and national trends described in section 4.1 break down into small-scale, sometimes contradictory development patterns. This illustrates the need for a database and analysis at the municipal level. The semi-peripheral region, which extends around the Sella Mountain range and whose five valleys are separated by mountain passes over 2000 metres high, has an inhomogeneous socio-economic structure with large differences in accessibility to centres and their labour markets, as well as in the intensity of tourism and the availability of local jobs. This results in selective migration and leads to corresponding problems in local development.

Figure 4.1. Migration balance (2002-2011) of the Ladin municipalities by age group

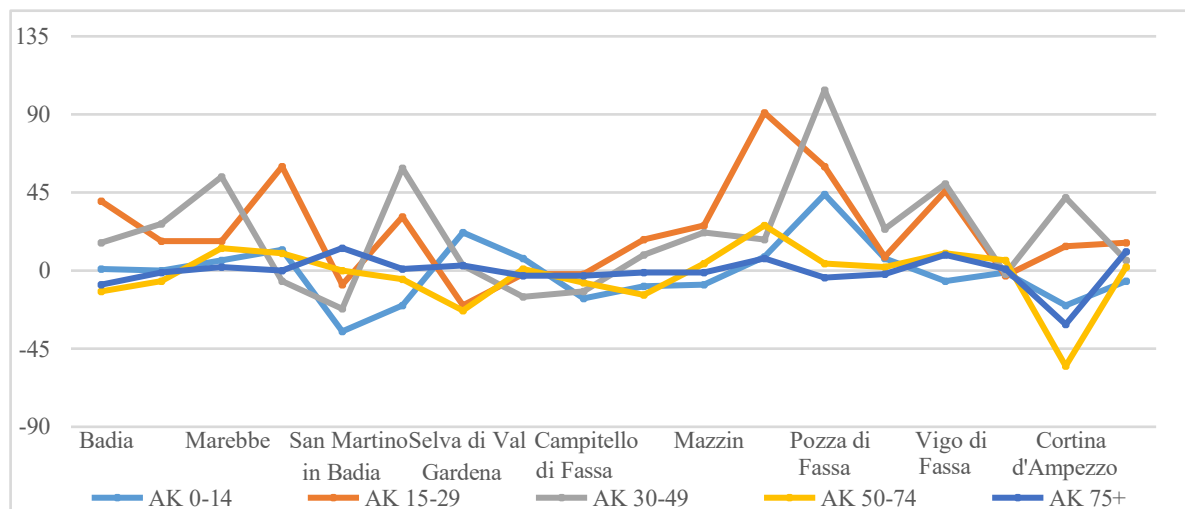
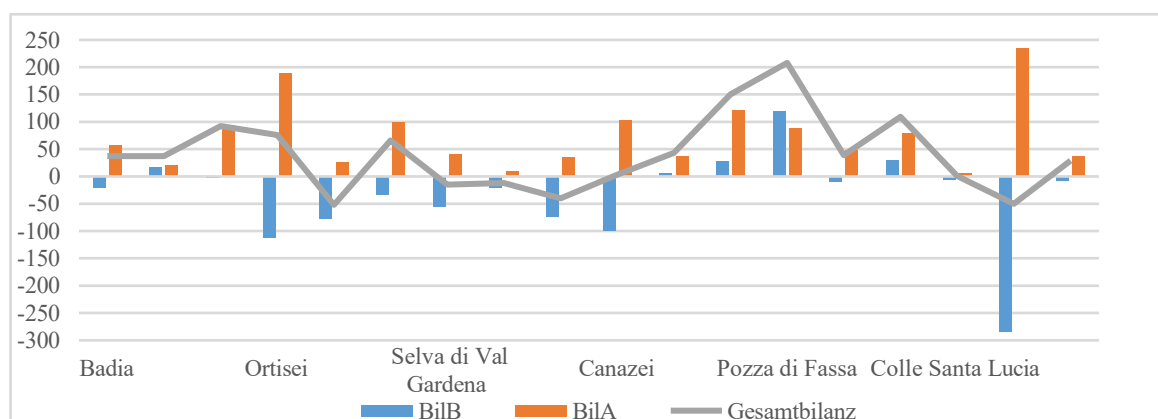


Figure 4.2. Migration balance (2002-2011) of the Ladin municipalities by internal (blue) and external migration (orange)



²⁵ The study is being conducted by Lea Held as part of her master's thesis at the University of Innsbruck and is supported by the Ladin Institute *Micura de Rü* in San Martino in Badia, Italy.

As expected, the highest migration gains are seen in the 15-29 and 30-49 age groups (Fig. 4.1). However, why the first category predominates in some municipalities and the second category in others require explanation and may be related to a diverging ratio of jobs and education places. The high gain in 30-49-year-olds together with people under 15 in Pozza indicates a high number of family settlements.

Here, it is necessary to examine whether the reasons lie in the availability of building plots and/or the attractiveness of the municipality as a residence place for commuting to other work locations. In some municipalities, high migration gains from abroad are offset by heavy losses in internal migration, especially in Cortina, Ortisei and Canazei. In these highly touristic locations, there is an increased need for foreign workers, while housing has apparently become too expensive for locals. Previous studies show how helpful migration data is in forming hypotheses about the causes of migration. The hypotheses must be corroborated by linking them to further data on the economic structure of the municipality and mobility behavior, as well as through interviews.

Another study is planned in the central region of North Tyrol, in Austria, which will document and analyse the advance of suburbanisation around the capital city of Innsbruck from the municipalities in the Inn Valley to the surrounding low mountain ranges – a very interesting case of valley exodus, in contrast to the well-known phenomenon of “mountain exodus” (*Bergflucht*).

This process is linked to increasing space requirements, the insufficient availability of building land with corresponding price increases, the expansion of public transport and, finally, climatic changes that are leading to increasing heat stress in urbanised valley locations. A mixed-methods approach will also be used here. This study will be carried out at the Institute for Interdisciplinary Mountain Research of the Austrian Academy of Sciences in the first quarter of 2026.

4.3 Regional study II: Climate change and human mobility in Trentino-Alto Adige/Südtirol

Regional study II²⁶ examines the relationship between climate change in the Italian provinces of Bolzano/Bozen and Trento.

Human migration is a multicausal, complex and non-linear phenomenon, in which environmental change is one of many factors that might influence the decision to leave or stay in a given location. In fact, determining the extent to which climate change causes migration is highly challenging, while the priority is to understand how climate consequences can alter current mobility patterns. Following this line of thought, a quantitative analysis combining climate change, residential mobility and socioeconomic factors is only one step towards a comprehension of mobility flows.

The methodology adopted in this regional study aims to identify correlations and not causality. Thus, it has two main goals. The first is the visualisation of the nexus between net mobility and climate indicators; the second is to measure the association between temperature variations and migration, focusing on differences between origin and destination.

Between 2014 and 2023, the study area has seen significant changes in seasonal temperatures. Data retrieved from Copernicus Climate Change Service (2019) shows that average summer temperatures have risen by at least 2.2°C when compared to the period 1970-2000. Average winter temperatures also show significant increases. Additionally, summers and winters have become drier as relative humidity has significantly decreased. The rising temperatures can also be observed through the increased average in “tropical nights”: while in 2014, the region had 1.5 days annually with minimum temperature above

²⁶ The study was conducted by Daniela M. Yáñez in 2025, as part of her PhD thesis.

20°C, in 2023, it has, on average, 6 days a year. Although heatwaves are less common, 2015 brought up to 15 days of record-high temperatures.

Looking closely at the two provinces of Bolzano/Bozen and Trento (Tab. 4.1), despite their geographical proximity, differences emerge. Trento is the province which has suffered from warmer and drier winters. Bolzano/Bozen, on the other hand, has faced warmer summers. Other climate-related indicators – detailed in the table – do not show significant differences in the area. Nevertheless, Trento stands out with a lower average of frost days per year in line with the warmer winters.

Table4.3. Climate change indicators by province

Climate change indicators by province (2014-2023)	Bolzano	Trento
Summer Temperature Anomalies (°C)	2.53	2.27
Winter Temperature Anomalies (°C)	2.51	3.15
Summer Humidity Anomalies (%)	-5.12	-3.43
Winter Humidity Anomalies (%)	-1.69	-2.53
Annual Tropical Nights	2	6
Annual Frost Days	77	69
Annual Extreme Precipitation Days	8	7
Annual Dry Days	90	93

Source: Daniela M. Yáñez’s elaboration based on data retrieved from Copernicus Climate Change Service (2019, 2024). Values shown are averages.

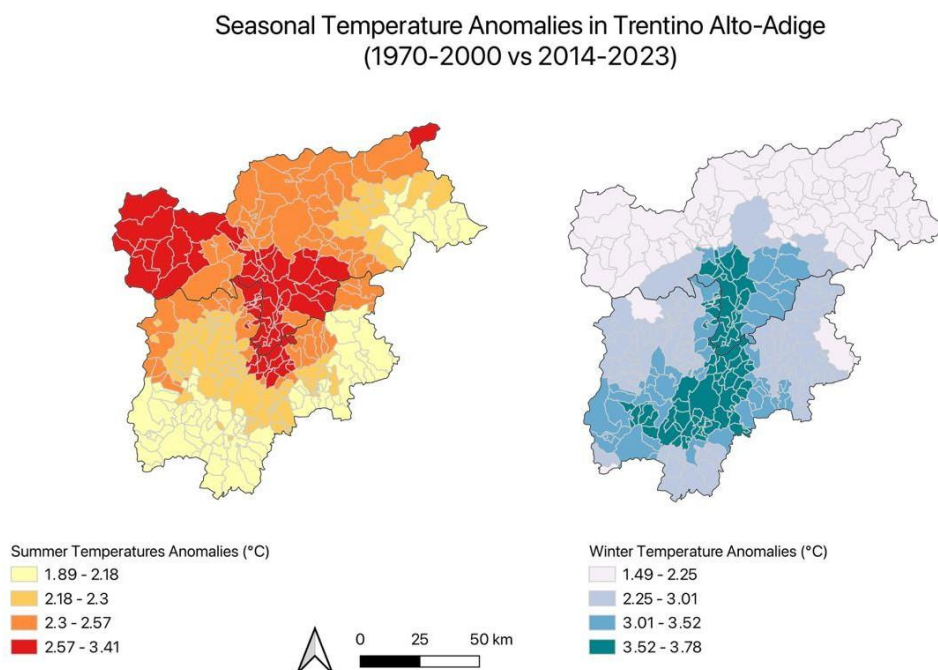
Recent surveys²⁷ indicate that Alpine residents are aware of climate change and its potential to disrupt daily activities. Indeed, the rising temperatures, changing rainfall patterns, and declining snow cover, have far-reaching implications for water availability, recreational activities, vegetation, mass movements, biodiversity, ecosystem services, and health. Variations can modify agricultural production, the length of the tourism season due to the lack of snow, biodiversity, and consumption (warmer summers can increase the demand for electricity). Moreover, the lack of climate mitigation and adaptation will increase temperature-related mortality, in particular in urban areas and considering more fragile social categories, as elderly people. Regional studies conducted in the study-area shed light on residents’ perception: about 88% of respondents in Trento are worried about life-altering impacts of climate change, while roughly 80% in Bolzano/Bozen acknowledge being concerned²⁸.

²⁷ Marot, N., Bevk, T., Debevec, M., Klepej, D., Stubičar, N., & Petrović Jesenovec, P. K. (2024). *Quality of Life in the Alps* (10th Report on the State of the Alps). Permanent Secretariat of the Alpine Convention. <https://www.alpconv.org/en/home/soia/report-on-the-state-of-the-alps/>.

²⁸ Source of information:
- for Trento: Laiti, L., Barbiero, R., Pieratti, E., & Delrio, P. (2023). *Risultati dell’indagine online sulla consapevolezza dei cittadini trentini sul tema dei cambiamenti climatici (marzo-giugno 2023)* (Programma di lavoro “Trentino Clima 2021-2023” verso la Strategia provinciale di mitigazione e adattamento ai cambiamenti climatici). Agenzia Provinciale per Protezione dell’Ambiente (APPA). <https://www.appa.provincia.tn.it/News/APPA-in-forma-Newsletter-periodica/Cambiamenti-climatici-in-Trentino.-Quanto-ne-sai-i-risultati-dell-indagine#>
- for Bolzano/Bozen: Windegger, F., & Kircher, C. (2024). *Indagine: Così pensa l’Alto Adige Emozioni e disuguaglianze nella crisi climatica*. Eurac Research & ASPAT. <https://doi.org/10.57749/ztxh-9674>

These findings underscore the importance of understanding the links between climate change, the quality of life and migration decisions. Such insights are crucial for designing effective adaptation strategies, planning urban development, considering strategies of risk mitigation/management, and forecasting demographic trends in Alpine regions. Given the positive net migration observed in Trentino-Alto Adige/Südtirol over the last decade, ongoing research aims to explore how climate change relates to residential mobility. Using ISTAT municipality-level data together with climate indicators, the analysis aims to identify correlations between the two phenomena and highlight climate impacts in the main destination areas. This quantitative approach, which combines climate, mobility, and socioeconomic factors, will provide an important first step in the overall understanding of mobility flows.

Figure 4.3. Seasonal temperature anomalies in Trentino-Alto Adige/Südtirol



Source: Daniela M. Yáñez's own elaboration, based on data retrieved from Copernicus Climate Change Service (2019, 2024). Values shown are averages.