

TELCO GEOBIGDATA FOR THE ANALYSIS OF PRESENCES AND MOVEMENTS: THE 2023 “ADUNATA DEGLI ALPINI” IN UDINE

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ABSTRACT:

The GEO Big Data phenomenon has become a central topic in the innovation debate. Understanding the presence and movement of individuals within a geographical area is crucial in many fields: urban planning, transport systems, emergencies, tourism, events, ... In the last few years a new source of information to reconstruct the dynamics of such complex systems are the data acquired from cellular phone that trace presences and movements with high precision. For privacy issues the data are sold geographically aggregated by TELCO companies. The study of the dynamics of incoming and outgoing, number of trips, number of days and nights spent, number of unique visitors, country of residence and origin, main destination, secondary destination, transit and repeated visits have been analysed for the annual gathering of the ALPINI held in May 2023 in Udine. This work demonstrates how accurate this information is and how it can be used, in addition to analysing the previous edition, to plan locations, logistics, and agendas for future editions.

1. ALPINI

1.1 Alpini Corps

The Alpini Corps, a specialized mountain warfare unit in the Italian Army, is renowned for its strength, agility, and resilience. With a rich history dating back to 1872, the Alpini are expert mountaineers, equipped to navigate treacherous terrains and harsh weather conditions.

Their distinct green uniforms, adorned with iconic feathered headdress called "Cappello dell'Alpino," symbolize their connection to the mountains.



Figure 1. Italian Prime Minister with “Cappello Alpino”

Committed to protecting Italy's alpine regions, the Alpini demonstrate exceptional discipline, teamwork, and adaptability. Through their training and unwavering spirit, they embody the essence of mountain warfare, embodying bravery and tenacity

in the face of adversity. In addition to their role, the Alpini Corps frequently engages in emergency response operations throughout Italy.

Their expertise and versatility make them valuable assets in natural disasters, such as earthquakes and avalanches, as well as during search and rescue missions.

The Alpini's commitment to serving their country extends beyond the mountains, as they bring their specialized skills and unwavering dedication to assist communities in times of crisis.

1.2 Alpini annual gathering

The annual gathering of the Alpini, known as " *Adunata degli Alpini* " is a momentous event that brings together thousands of proud members of the Alpini Corps.

Held in different cities each year, it is a vibrant display of camaraderie, tradition, and national pride.

The streets come alive with marching bands, colourful flags, and the iconic green uniforms of the Alpini.

The *Adunata degli Alpini* is a time for reunions, remembrance, and celebration of their shared values. It showcases the Alpini's deep connection to the mountains and serves as a powerful reminder of their unwavering dedication to serving Italy and its people.

During the four-day *Adunata*, a flurry of activities and events take place. The city hosting the gathering becomes a bustling hub of energy and excitement. Parades fill the streets, accompanied by stirring music and cheers from both participants and spectators.

The Alpini proudly showcase their rich traditions through ceremonies, exhibitions, and cultural performances. There are gatherings to honor fallen comrades, where poignant moments of remembrance are shared.

Camaraderie is forged through social gatherings, where stories are exchanged and friendships are strengthened.

The *Adunata* is a time of unity, pride, and a celebration of the indomitable spirit of the Alpini Corps.



Figure 2. Poster for the *Adunata degli Alpini* in Udine

1.3 Reasons for the analysis

Conducting an analysis of the attendance and origins of the *Adunata* in Udine can be immensely beneficial for the city. Such an analysis provides valuable insights into the economic, cultural, and social impacts of the event.

By understanding the demographic composition of attendees, the city can tailor its services and infrastructure to accommodate their needs effectively. It allows local businesses to anticipate and cater to the increased demand during the gathering, boosting the local economy.

Additionally, analysing the origins of participants helps identify potential tourism trends, enabling targeted marketing strategies to attract visitors from specific regions.

This data also facilitates the evaluation of the event's effectiveness in promoting Udine as a tourist destination. Furthermore, the analysis aids in assessing the event's impact on community engagement, fostering a sense of pride and belonging among the locals.

By evaluating the overall success of the gathering, city authorities can make informed decisions to improve future editions, ensuring a memorable experience for both participants and residents.

Ultimately, analysing the presence and origins of the *Adunata* empowers Udine to maximize the event's benefits and enhance its status as a vibrant host city.

2. TELCO DATA DESCRIPTION

2.1 Region Friuli Venezia Giulia and University of Udine

Friuli Venezia Giulia (FVG) is the northeasternmost region of Italy and shares its borders with Slovenia to the east, Austria to the north, and Veneto to the west. It is strategically located for

road communications towards Austria, Germany, and Eastern European countries.

The region offers several tourist destinations both for summer and winter vacations. It has always shown a keen interest in analysing and organizing tourist flows and destinations, facilitated through its own Destination Management Organization (DMO) called Promoturismo FVG.

This interest led Region Friuli Venezia Giulia to become the first region in Italy to establish a subscription with a TELCO (telecommunications company) back in 2016, in order to leverage data for obtaining precise information and making well-informed decisions.

The Geomatic Laboratory of the University of Udine has been providing valuable support to the Region with its expertise in computer science, statistics, and territorial analysis. Numerous analyses have been carried out concerning events (such as the Barcolana sailing regatta, football matches, concerts, etc.) as well as tourist destinations by the sea and in the mountains.

2.2 TELCO data technical description

The data is collected from individual mobile phones by telecommunication companies (TELCOs).

With the current available networks, an average of 1,200 positions per day is stored derived by each activity performed by a smartphone (e.g., receiving/sending messages, app updates, connecting to a new antenna, etc.) approximately one position per minute.

The precision of this location data depends on whether the device's GPS is active or if it is calculated through the triangulation of signals from the antennas the smartphone is connected to. The denser the network of antennas, the higher the precision of the location data.

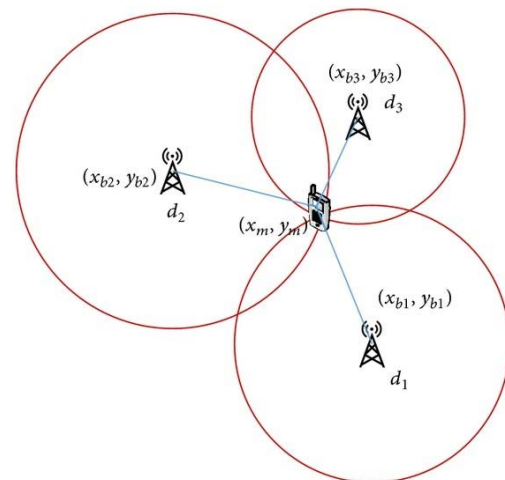


Figure 3. Smartphone position by triangulation

In the case the GPS is not on, the location data is quite precise, with an error margin of 5-15 meters, in urban areas and 300-1,000 meters in rural areas.

For privacy reasons, this data is aggregated geographically into minimum units, represented by cells measuring 150x150 meters, and temporally in 15-minute intervals, which can be further grouped based on the types of analysis and the client's specific needs.

The data sold by the TELCO represents the entire population, not just the subscribers of the individual TELCO. To achieve this, the collected data from their SIM cards is processed using mathematical and statistical models that consider, among other factors, the TELCO's market penetration in the specific area.

Various data verification activities have been conducted by the Geomatic Lab of the University of Udine, using events in isolated locations where ticketing data was precisely known. For example, football matches in stadiums or concerts in secluded places with no other influences. These verifications have consistently shown a very low percentage of error, always within the range of 1-3%.

Using this data, you can address questions such as:

- How many people are present in a specific place at a certain time?
- Where do they come from?
- Where do they'll go later?
- What is the average duration of their stay?
- Which places do they visit?
- Where are today the people who arrived yesterday with a certain flight?
- How do behaviours change based on their origin?
- And more

2.3 Used Dashboard

The TELCOs typically make data available through dashboards that allow users to set various filters. The data is presented in both tabular format and through graphs and histograms. Additionally, users can export the information in various formats such as Excel, Access, CSV, and more.

The Region FVG utilizes the WIND3 dashboard, which is described below.

The WIND3 dashboard provides a user-friendly interface for accessing and analyzing the data. It offers the following features:

- **Data Filters:** The dashboard allows users to apply filters to the data based on specific criteria. These filters could include geographical areas, time intervals, demographic characteristics, or any other relevant parameters.
- **Tabular Representation:** The data is presented in a tabular format, providing a structured view of the information. Users can access detailed data points and associated attributes.
- **Graphs and Charts:** The dashboard visualizes the data through graphs and charts. This visual representation aids in understanding trends, patterns, and relationships within the data.
- **Histograms:** Histograms are graphical representations of the data distribution. They help identify the frequency of occurrences within specific ranges or categories.
- **Export Options:** The dashboard allows users to export the data in various formats such as Excel, CSV, and others. This facilitates further analysis and integration with other tools or systems.

Overall, the WIND3 dashboard streamlines the process of accessing, analysing, and visualizing the data provided by the TELCO. It empowers users to gain insights and make data-driven decisions for various purposes, including tourism analysis, traffic management, and urban planning, among others. In the next paragraph the main functional features will be described.

2.3.1 Presence and origins

This function allows, after selecting a period and one or more municipalities, to obtain the number of people present in each

selected municipality, on each selected day and on the selected time windows, divided by type:

- **Resident:** individuals who have predominantly spent their nights in the municipality over the last 3 months.
- **City user:** residents of another municipality who visit the selected municipality for at least 20 days a month (e.g., workers, students, etc.).
- **Regional:** residents within the region, with their municipality of origin indicated.
- **National:** residents from outside the region, with their province of origin indicated.
- **European:** residents from European countries, with their nation of origin indicated.
- **Intercontinental:** residents from outside Europe, with their nation of origin indicated.

Additionally, the data can be further categorized by gender and age groups.



Figure 4. Presences menu interface

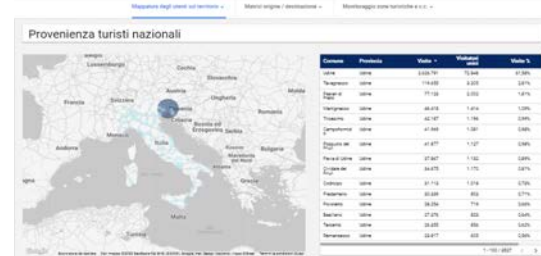




Figure 5. Origins menu interface

2.3.2 Origin Destination Matrix

The Origin Destination (OD) matrix function allows, after selecting a period, one or more origin municipalities, and one or more destination municipalities, to obtain the number of people who have moved from each origin municipality to each destination municipality, categorized by type (residents, city users, foreigners, ...) and with a breakdown of the trips based on the time taken.

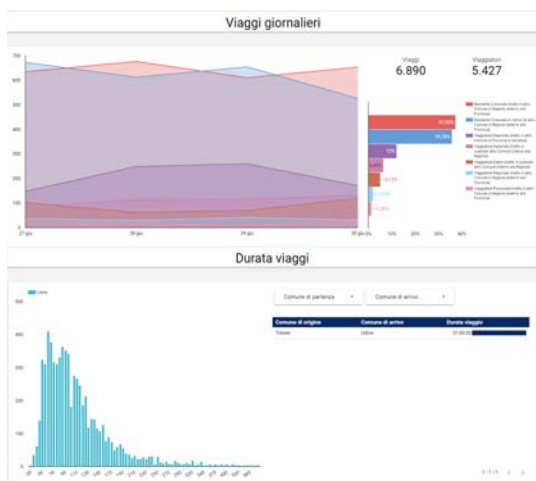


Figure 6. OD matrix menu interface

With this function, it is possible to calculate the attractiveness of a territory and understand the means of transportation used for the movements.

By analyzing the OD matrix, you can determine the number of people traveling from different origin municipalities to various destination municipalities at a certain time. This data provides valuable insights into the attractiveness of specific areas or destinations. For instance, a higher number of people traveling from various regions to a particular municipality could indicate its popularity and appeal as a destination or the early morning trips the number of students and workers reaching a certain destination.

Moreover, the breakdown of trips based on the time taken can reveal information about the means of transportation used for these movements. Slow trips may suggest walking or cycling, while fast trips might indicate the use of public transportation or private vehicles.

By combining the OD matrix data with information about transportation modes, authorities and planners can gain a

comprehensive understanding of travel patterns, identify areas with higher demand, and make informed decisions regarding infrastructure development, transportation services, and tourism strategies

2.3.3 Tourist Zones and Points of Interest

To activate this function, the TELCO was provided with a list of locations to monitor within the region. These locations include shopping centers, border crossings, tourist destinations, intermodal stations, and more.

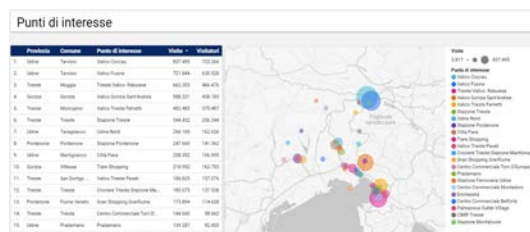


Figure 7. List and Cartography of Points of Interest

The boundaries have been digitized on the digital cartography with great precision, and the Telco is able to obtain, within these specific areas, all the data on presence and origin in different time slots, exactly as we have seen in the previous paragraphs.

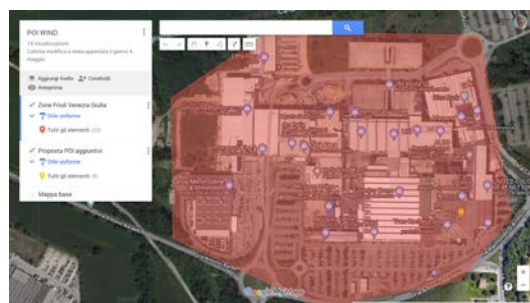


Figure 8. An example of digitizing the boundaries of a shopping center

3. ADUNATA DEGLI ALPINI PRESENCE ANALYSIS

Now let's delve into the details of the use case of the *Adunata* that took place in Udine from May 11th to May 14th, 2023, culminating in a parade that started at 9 AM and ended at 6 PM. In the days leading up to the parade, the Alpine troops sang, played instruments, and enjoyed food and drinks in the city streets together with the residents.

In addition to analyzing the absolute number of presences and origins in various time slots, a period with similar characteristics in terms of both the days of the week and weather conditions was also selected, which was not too far from the event (May 5th to May 7th).

This choice allows for calculating the percentage differences in attendance relative to a "normal" reference period.

This edition was rather unfortunate as it rained almost continuously throughout all the days of the *Adunata* but the

Alpine troops once again demonstrated their resilience and were not affected by the weather conditions

3.1 Presences

The project has generated a significant amount of data, which we will now describe here. When evaluating the data, it should be considered that the resident population in Udine is approximately 100,000 inhabitants.

During the period of the *Adunata* there was a recorded increase in visits of +90% (equivalent to 143,323) and a +64% increase in unique visitors (equivalent to 68,139).

In the Municipality of Udine, during the days of the event, an increase was observed compared to the previous week, particularly on Sunday with a +360% rise (amounting to over 70,000 people).

Regarding the time slots, there was an increase in attendance starting from the early afternoon of Friday. The most significant percentage increases occurred on Sunday morning, especially in the time slot from 6:00 AM to 8:59 AM, during which the troops were assembled and honors were paid to the highest authorities before the parade at 9:00 AM.

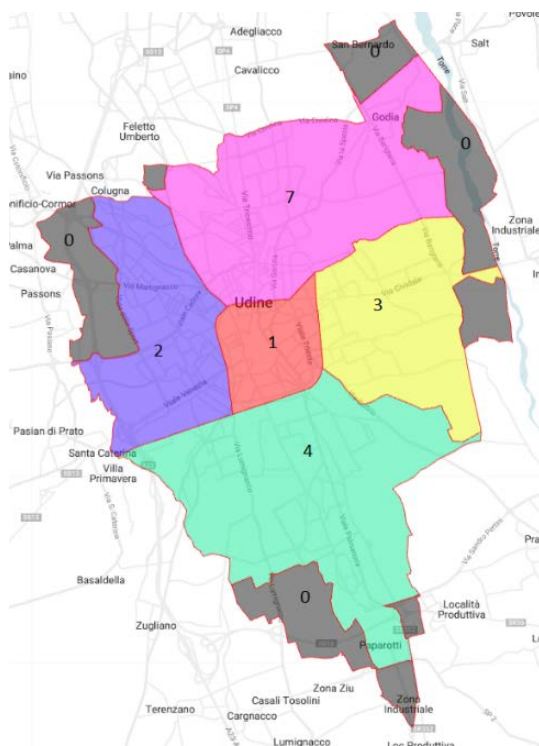


Figure 9. The Municipality of Udine divided into census zones

In the center of Udine, area 1 of Figure 9, the peak of attendance at the Sunday parade is recorded in the time slot from 12:00 PM to 2:59 PM, with 36,653 attendees.

3.2 Origins

Regarding the origins of the attendees, these are the total data concerning unique visitors observed during the period of the *Adunata* in the Municipality of Udine.

Visitors “normal” days	106.959
Visitors ADUNATA days	175.098
Intercontinental	525
European	7.354
National	73.891
Regional	20.136
Provincial	73.191

Table 1. origins of presences in the Municipality of Udine

So, the increase in attendance during the period was 64%, with a 360% peak if we analyze only the parade day.

Now let's focus on the parade day, Sunday, to analyze the major increases in attendance.

Cuneo	14.087%
Trento	8.826%
L'Aquila	8.689%
Vercelli	8.525%
Alessandria	8.111%

Table 2. Italian Provinces with the highest percentage increase

Svezia	1.133%
Albania	500%
Svizzera	407%
Irlanda	200%
Portogallo	175%

Table 3. Countries with the highest percentage increase.

As you can see from Tables 2 and 3, there are indeed very significant increases.

3.3 Hub overnight stays

To manage such a massive presence and the related accommodation capacity, HUBs were organized in 15 municipalities surrounding Udine, where Alpine Groups from various origins could book places.

From the analyses conducted on Saturday night, there were over 6,000 overnight stays in these HUBs.

To count the overnight stays, the presence in the HUB municipalities during the time slot from 3 AM to 6 AM was considered.

In addition to the overnight stays in the HUBs, there were also accommodations in the Municipality of Udine, which increased compared to the “normal” period and were particularly numerous on Friday and Saturday nights., the percentage increases are +418% (over 21,000 people) and +559% (over 28,000 people), respectively.

It should be noted that both in the HUBs and in the Municipality of Udine, most of the Alpine troops slept in

specially constructed camps in all available parks and green areas (Fig 10).



Figure 10. camp

3.4 Saturday night

During the Saturday evening preceding the parade, all the Alpine troops gather in the streets of Udine, where food and wine stands are set up, and various musical bands perform impromptu concerts in different corners of the city.



Figure 11. the city in celebration

The city is in celebration, and all citizens, children, adults, and the elderly, are involved in singing and dancing. At the peak moment of the evening, from 9 PM to midnight, there were more than 91,000 people in addition to the residents and city users, almost twice the normal attendance.

3.5 Sunday parade

The parade is the most exciting moment of the *Adunata*. It is attended by the most important national politicians, including the head of state, the prime minister, the defense minister, the mayor of the Udine and others. All the citizens and visitors gather around Piazza Primo Maggio, the central main square and park of the city of Udine.



Figure 12. the parade

In Figure 13, the graph shows the attendance per time slot in the central area of Udine on the Sunday of the parade. The blue bars represent the attendance on the parade day, and the orange bars represent the attendance on the previous week's Sunday.

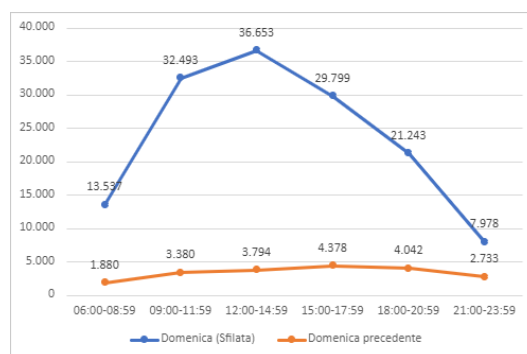


Figure 13. Attendance per time slot on Sunday in the center of Udine compared with the “normal” Sunday

This year, despite the rain, over 100,000 Alpine troops marched in the parade for 12 hours, demonstrating an unwavering attachment to the Alpine Corps

4. CONCLUSIONS

The data used for this work has been thoroughly verified in very specific situations with official sources and has proven to be highly accurate.

The speed of updates, precision of information, geographical, and temporal granularity make these data unique and will become an essential analysis tool in the coming years, eliminating the need for decision-makers to rely on approximate information obtained through empirical methods.

The working group at the GEOmatica laboratory has prepared a series of libraries capable of automatically generating dashboards specific to each event or location, starting from raw data and applying the appropriate temporal and geographical filters.

In conclusion, the analysis of the data from the *Adunata degli Alpini* event in Udine has provided valuable insights into attendance patterns, origin locations, and temporal trends. The data, collected and processed with high precision, has allowed

for a comprehensive understanding of the event's impact on the region.

The significant increase in attendance during the event, even in adverse weather conditions, highlights the strong attachment and dedication of the Alpine troops to their corps. The successful organization of HUBs in surrounding municipalities and the notable rise in overnight stays demonstrate efficient management of accommodation needs.

The availability of such accurate and granular data has proven to be an essential tool for decision-making, providing reliable information for planning and resource allocation. The ongoing efforts to develop automated libraries for data analysis and the future integration of Artificial Intelligence and Machine Learning techniques promise even more powerful and sophisticated insights for future events integrating social media data for a sentiment analysis of the visitors.

Overall, the combination of TELCO data and social media analytics holds immense potential for enhancing event management strategies and understanding the sentiments and behaviors of participants. With continuous advancements in data analytics and technology, these insights will undoubtedly become even more valuable in shaping successful events and optimizing regional tourism strategies.

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