

## **Part 3: Model Graubunden**

# 1. INTRODUCTION

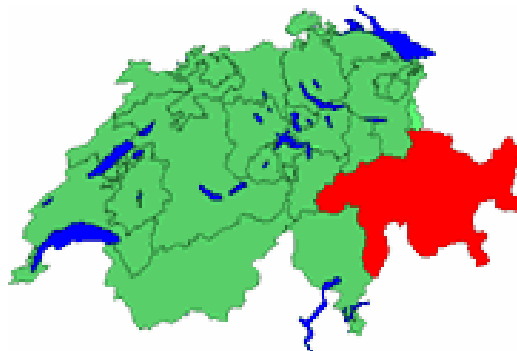
## 1.1 Facts about Graubünden

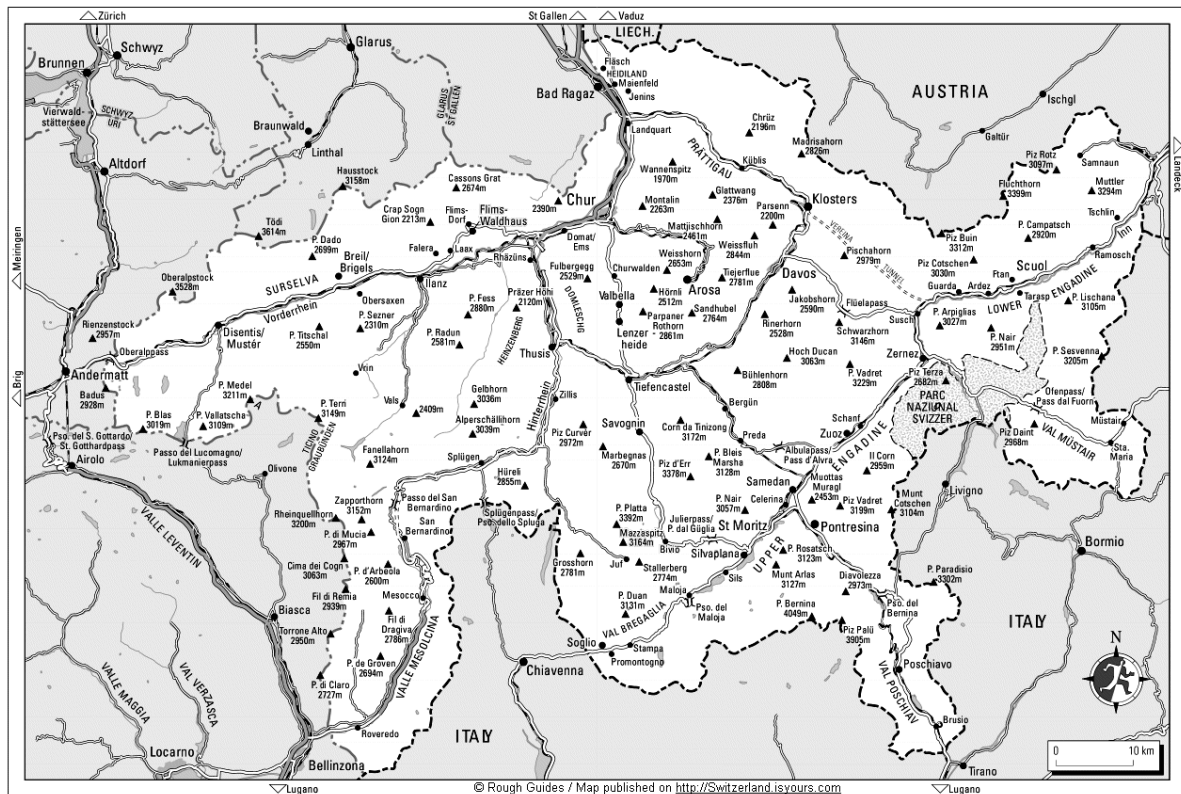
This is the canton of 150 valleys. It reflects the diversity of Switzerland on a small area. From the Rhine valley to the Bernina massif, the idyllic alpine scenery with mountain lakes, deep and wild gorges, and wide valleys, all enjoy a southern climate. The canton of the Grisons has 3 official languages, which are German, Romanisch and Italian and each region still follows their traditions. Apart from the reputed ski resorts such as St. Mortiz, Davos, Arosa, Flims and Lenzerheide, new resorts have been developed that can fulfil the wishes of the most demanding sports enthusiast.

Switzerland's largest canton, Graubünden occupies the entire southeast of the country and takes in a huge but sparsely populated area that's the most culturally diverse in Switzerland, bordering on Liechtenstein and Austria to the north, and Italy to the east and south. Its folded landscape of deep, isolated valleys (well over a hundred of them), sheer rocky summits and thick pine forests makes it the wildest and loneliest part of Switzerland, more difficult than most to get around in, but also more rewarding, with some of the finest scenery in the Alps. Glaciers oozing from between the high mountains launch two of Europe's great rivers – the Rhine and the Inn – on their long journeys to the North Sea and the Black Sea respectively, while two smaller rivers water pomegranates, figs and chestnuts in secluded southern valleys en route to the Po and the Gulf of Venice.

The canton – once the Roman province of Rhaetia Prima – is officially trilingual, known as *Graubünden* in German, *Grigioni* in Italian and *Grischun* in Romansh the last of these a direct descendant of Latin which has survived locked away in the mountain fastnesses far from the cantonal capital Chur since the legions departed 1500 years ago.

**Figure 21. Graubünden:situation in Switzerland and map**





## 1.2 Road network

The road network in canton Graubünden is conditioned by the geography of this land. The highways follow the track of the alpine valleys and as a result its way is plenty of turns and slopes. That situation is worsened in the alpine passes (a shortlisted relation of the passes in Switzerland is showed in the appendix 9) that are very common in this canton. It must be quoted that some passes are closed in winter.

About the freeways there is just a link of N-13 traversing the canton in a North – South direction. In its way of 128,5 kilometres the freeway goes through the San Bernardino pass with the help of a tunnel of almost 7 kilometres. That fact is important in order to analyse the accessibility because if the study focuses on the freeways in the canton, just one axis would be studied and thus the results would not be representative.

As it is showed in the appendix 10 the cantonal highways and local roads constitute a network of about 3,500 kilometres. That enables a chance to study that network and therefore the change in private car accessibility to this territory in the period 1950 – 2000.

## 2. MODEL

The model implemented to study the accessibility in canton Graubunden focuses in the development in the cantonal highways as well as the local roads. Obviously the construction of the National highway N – 13 in this time is taken into account for the study.

The methodology to implement the improvement in the network is to identify the new links opened in that time, specially some mountain passes. Alternatively, the construction of the by – passes around the big and middle towns is identified. That makes the travel speed to increase.

Concerning to the speed trough the time, the same values for the different kinds of road of the table 1 are taken. Also the values for the capacity are taken from the table 2.

In addition to that, the data for the population are the same used in the model for the freeways, so there is no need to implement that again. The general trends for the progress in population in Graubunden in the period 1950 – 2000 coincide with the one in the mountain areas. That is to say, the trend is to grow in the valleys with tourist attraction (upper and lower Engadin) and in the capital Chur and to decrease in all the other areas. That is shown in the figure 10.

The size of the network trough the time is showed in the appendix 12. As mentioned the main change is the construction of the freeway.

On an overall view the proceeding here is analogue to the used formerly in the Part 2. The year of opening of the links in the network is taken from Schweizerischen Autostrassen-Vereins (div years)

As before an "all-or-nothing" traffic assignment is used to calculate the travel time from each municipality to every other municipality in canton Graubunden. This yields a 294 x 294 matrix, applying nearly 100,000 trips on the road network (i.e., one trip between each zone).

The justification to study the variation in accessibility in canton Graubunden in this time is the low values resulted in the model for the freeways. This region has in year 2000 only a fifth part of the mean accessibility of Switzerland calculated in the model freeways as it can be seen in the figure 19. Although the improvement in that period of about 300 % is similar to the overall one for the totality of Switzerland.

### **3. ACCESSIBILITY MEASURES AND PROGRAM**

The accessibility measures used here are the same ones that in the model for the freeways. Thus, the municipality measure is used as the potential measure. As contour measures also the isochronal approach and the travel times from Chur are used.

For the isochrones the intervals of 15, 30, 45, 60, 90 and 120 minutes are used. The travel times are set to six main towns in the canton: Arosa, Davos, Disentis, Roveredo, Scuol and St. Moritz. These urban areas represent all the directions from Chur. They also vary in distance to Chur and number of inhabitants.

Therefore their travel times are a good measure to analyse the decay of the cost of travelling from or to Chur. The goal here is to analyse the curve of the travel time through the decades with aim of detecting a trend.

The only difference is that the cantonal accessibility is obviously not used in this case.

Concerning to the program. the runs are made with the program showed in the appendix 2 that does not account for the activity points in the origin itself. That is, the population living in the own city or village. That way of calculating accessibility is more reasonable. If the purpose is to study the motorway network, it is logical to assume that little travels have like origin and destination the same node (that would imply urban trips). Some exceptions can be made to that assumption (e.g. the motorways around the big urban areas). Nevertheless, these cases are not common in canton Graubünden.

## **4. RESULTS**

### **4.1 Isochronal approach.**

The results are shown in the appendix 13.

The change in the area reached within the same time happens gradually and there is not a decade when the progress is clearly bigger than in the other ones.

In 1960 one could reach the Davos and Disentis in two hours while in 2000 within the same time this boundary broadens as far as the Bernina pass and the beginning of the lower Engadine. The towns before mentioned can be now reached in one hour.

### **4.2 Travel time**

The results are shown in the appendix 14.

These numbers show that the travel times nowadays is at least the half it used to be. That represents a much lower travel cost for the individuals and in consequence the easiness of travelling by car.

In the figures is represented a gradual decrease in the travel time from 1960 to 1990. In the period 1990 – 2000 there is not a relevant change.

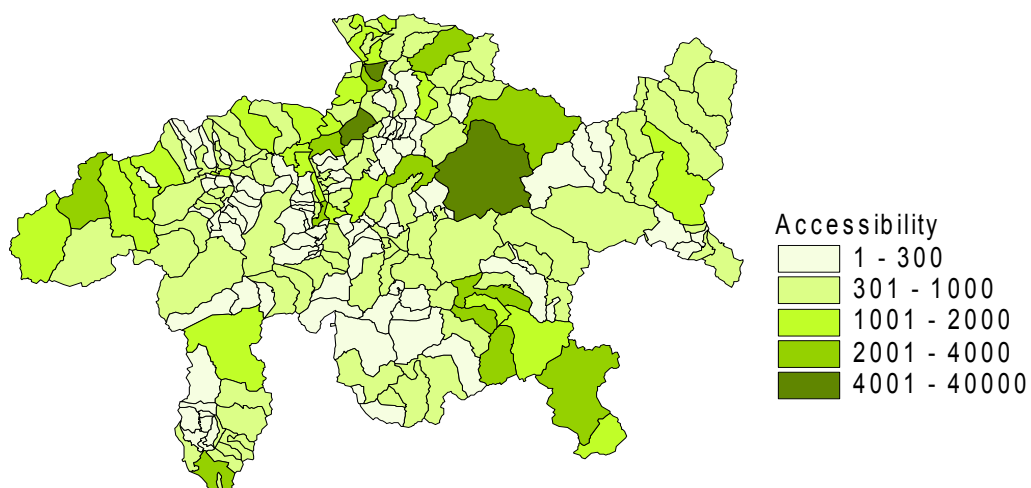
### **4.3 Potential accessibility**

In 1960, the major urban areas (see Figure 22), Chur, Davos and Landquart had a clear absolute accessibility advantage over the other parts of Switzerland as the most populated areas. The only area of high accessibility is in the Upper Engadine. With the exception of the Inn valley, large parts of the mountain regions have low accessibility values. The Rhin valley has a medium value for the accessibility.

In 2000 (see Figure 23) the locations in the highest measure of accessibility are concentrated in a circular area around Chur. Along the Engadine valley, the accessibility is high specially in the lower and upper parts. Now the accessibility in the Rhin Valley has a good measure. Last but not least the N - 13 mark can be tracked in its way from the North to canton Ticino.

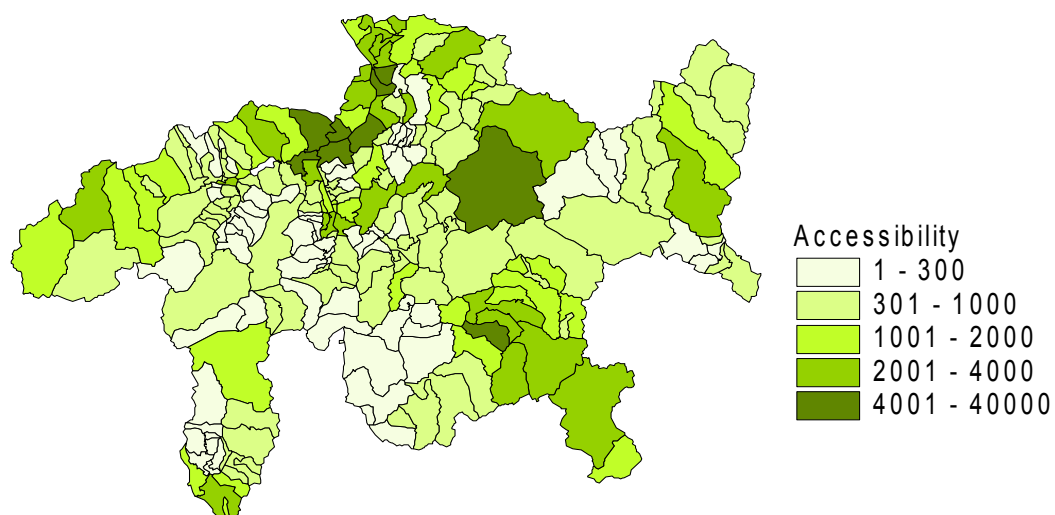
**Figure 22. Municipality accessibilities in year 1960**

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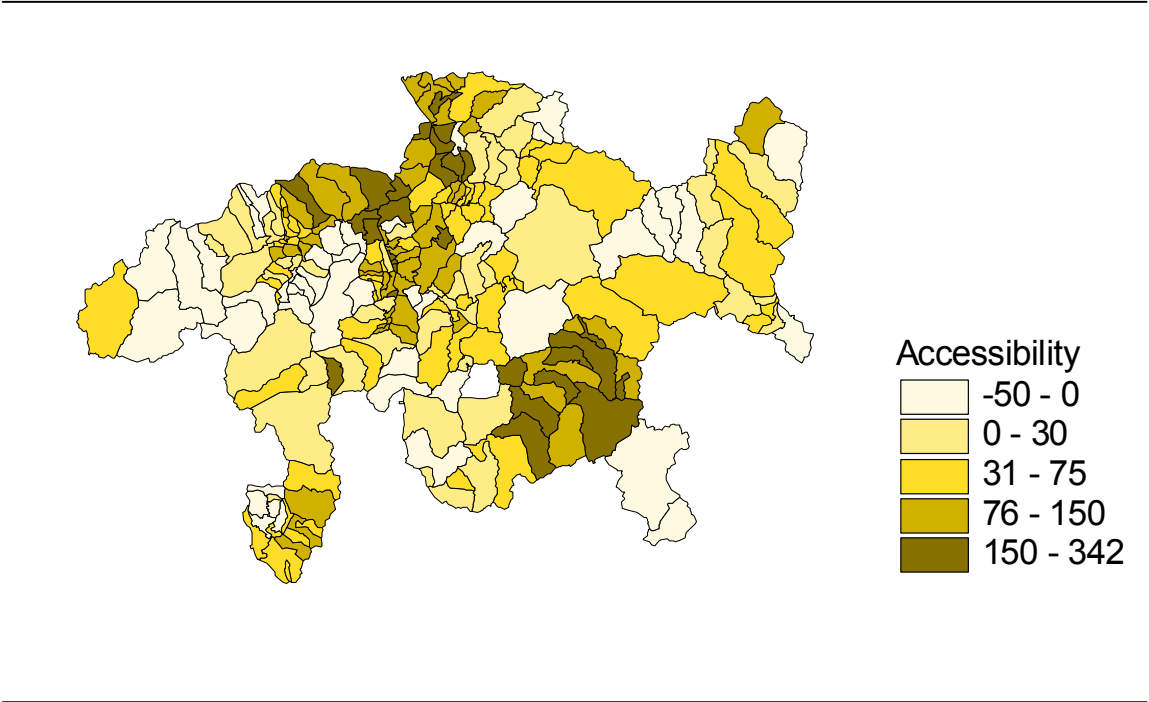
**Figure 23. Municipality accessibilities in year 2000**

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If the accessibility changes between 2000 and 1950 are considered (see Figure 24), the removal of San Bemardino (N 13) bottleneck is representative. Additionally, the central part of the canton and the area around St. Moritz have experienced a high growth in accessibility.

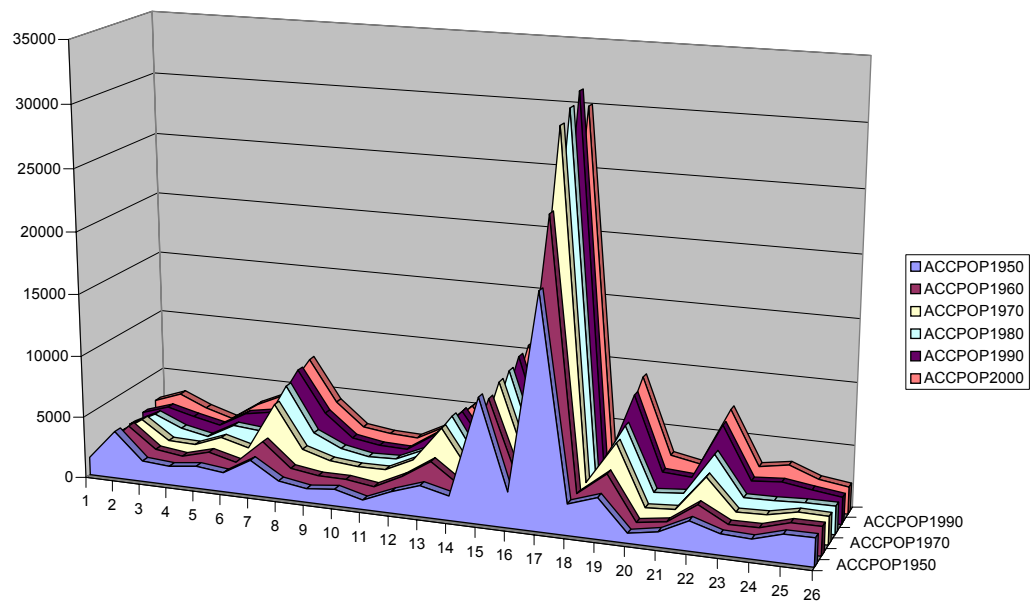
**Figure 24. Gain in accessibility 1950 - 2000**



**Figure 25. 26 communities in canton Graubunden**

Community	Name	Community	Name
1	Vaz	14	Roveredo
2	Poschiavo	15	Davos
3	Ilanz	16	Klosters
4	Cazis	17	Chur
5	Thusis	18	Arosa
6	Bonaduz	19	Igis
7	Domat	20	Trimmis
8	Felsberg	21	Untervaz
9	Flims	22	Zizers
10	Scuol	23	Maienfeld
11	Pontresina	24	Malans
12	Samedan	25	Schiers





## **5. DISCUSSION**

The major conclusions are explained in the section 6 of the part 2 because the measures applied are the same. The only but significant difference is the network studied in each case. In the first case (Switzerland), just the National highway network change is considered, while for Graubunden all the kinds of road are included in the study.

Nevertheless the study for Graubunden is like in the freeways case not complete. In the present model, only opportunities within Graubunden are considered, but some areas (Chur, St Moritz, etc.) are close to the border. This means that the model must be enlarged to the border areas in neighbouring countries and cantons in order to be more realistic

Some differences are anyway remarkable. In the first place, the decay of the travel time is different in these two cases. In Graubunden there is a gradual decay, while in the Swiss case, the mean decay happens in the period 1970 – 1980.