Preferred citation style for this presentation

Fröhlich, Ph. and K.W. Axhausen (2005) Large Scale Accessibility Study: Which level of accuracy is necessary ?, Committee Transportation and Land Development presentation, TRB Annual Meeting, Washington, D.C., January 2005.

Large Scale Accessibility Study: Which level of accuracy is necessary ?

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January 2005

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Motivation: The mistaken logic of public capital

The literature since Aschauer (1989) assumes:

$$\Delta y(t) = f(\Delta p(t), \Delta x(it))$$

with

$\Delta y(t)$: GNP, productivity change
$\Delta p(t)$: Road or other transport capital change
$\Delta x(it)$: Change in other relevant variables

Does this work ?

Implicit assumption:

$$\Delta p(t) \sim \Delta \text{Network services}(t)$$

but this implies constant proportionalities for each of the following:

$$\Delta p(t) \sim \Delta \text{Lane miles}(t)$$
$$\Delta \text{Lane miles}(t) \sim \Delta \text{Capacity}(t)$$
$$\Delta \text{Capacity}(t) \sim \Delta \text{Speed}(t)$$
$$\Delta \text{Speed}(t) \sim \Delta \text{Accessibility}(t)$$
$$\Delta \text{Accessibility}(t) \sim \Delta \text{Network services}(t)$$

Approach

Tracking the road and public transport-based accessibility changes in Switzerland from 1950 to 2000 in 10 year steps.

$$Acc_i = \sum_{\forall ij} X_j \, e^{-\beta c_{ij}}$$

Using:

- Weighting parameter (β) of 0.2
- Travel time as the only generalised cost element (c_{ij})
- Population as number of opportunities (X_j)

Description of Elements (1)

Study area:	Switzerland and surrounding jurisdictions in a 350 km band
Spatial resolution:	Municipality equals one zone Larger municipalities are subdivided Zones outside Switzerland on regional or county level
Network resolution:	All major road developments inside Switzerland and motorway development outside

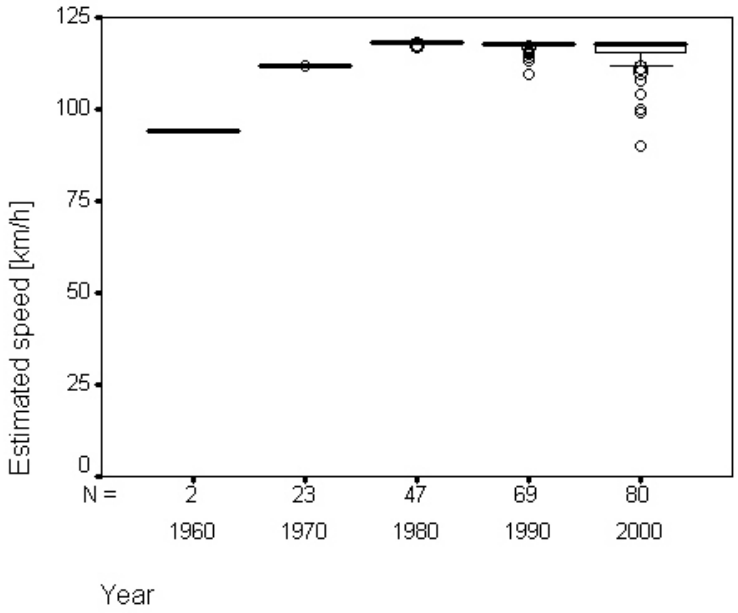
Description of Elements (2)

Link description:	Assumed mean speeds by 51 link types based on a detailed historical review
Intrazonal travel times:	Dependent on equivalent radius of the size of the built up area
Centroid connectors:	Fixed speeds
Travel time calculation:	Time-shortest paths

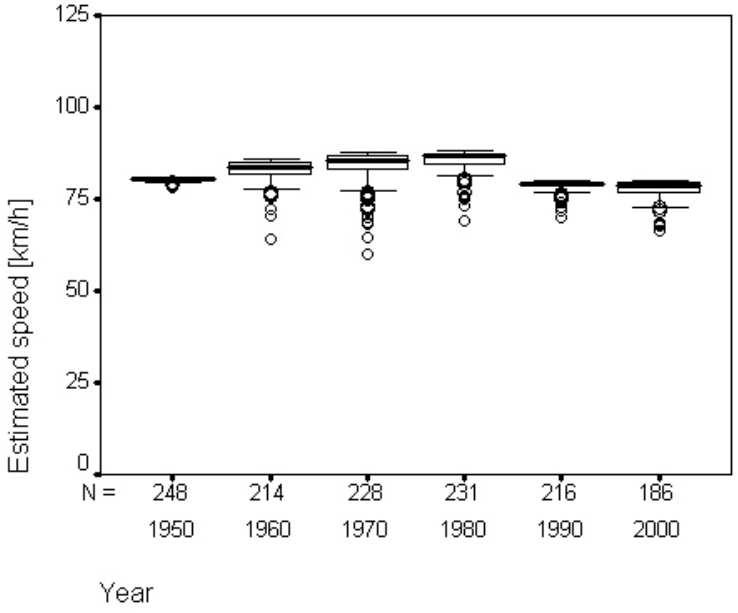
Road network models

Year	mod. Links CH	Total CH Links CH	mod. Links EU	Total Links EU
1950	3’527	17’698	136	29’248
1960	3’589	17’760	195	29’307
1970	4’147	18’318	422	29’534
1980	4’810	18’981	747	29’859
1990	5’215	19’386	896	30’008
2000	-	19’700	-	30’053

Development of average speeds on Swiss roads



Two-lane motorways

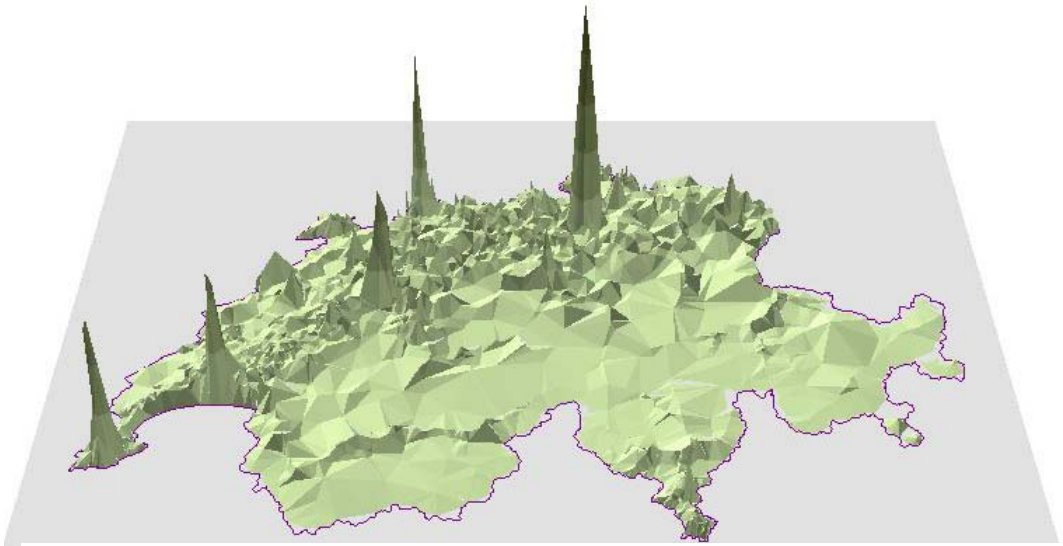


Trunk roads

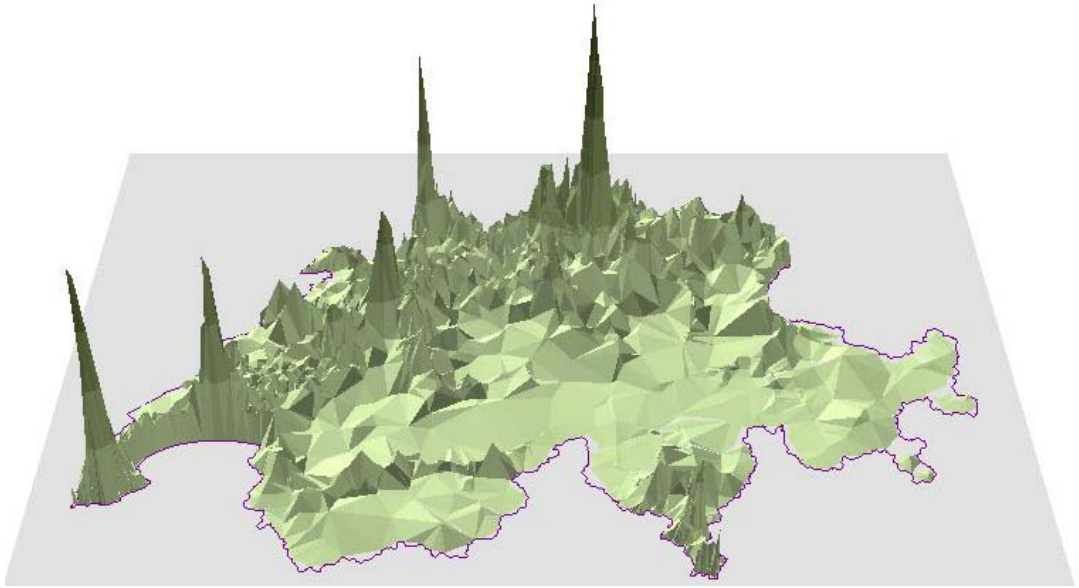
Axhausen und Fröhlich, 2004

Road-based accessibility 1950 and 2000

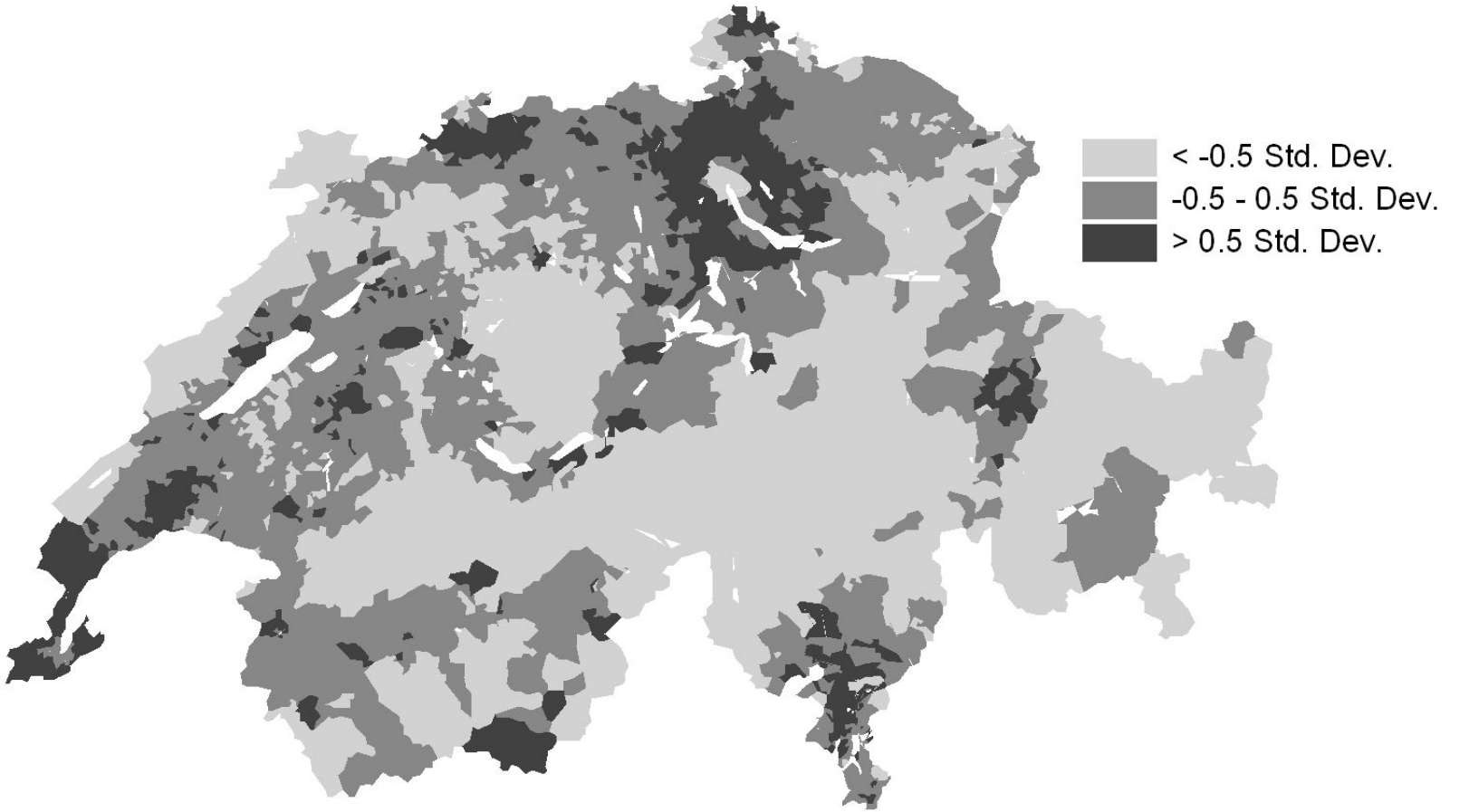
1950



2000

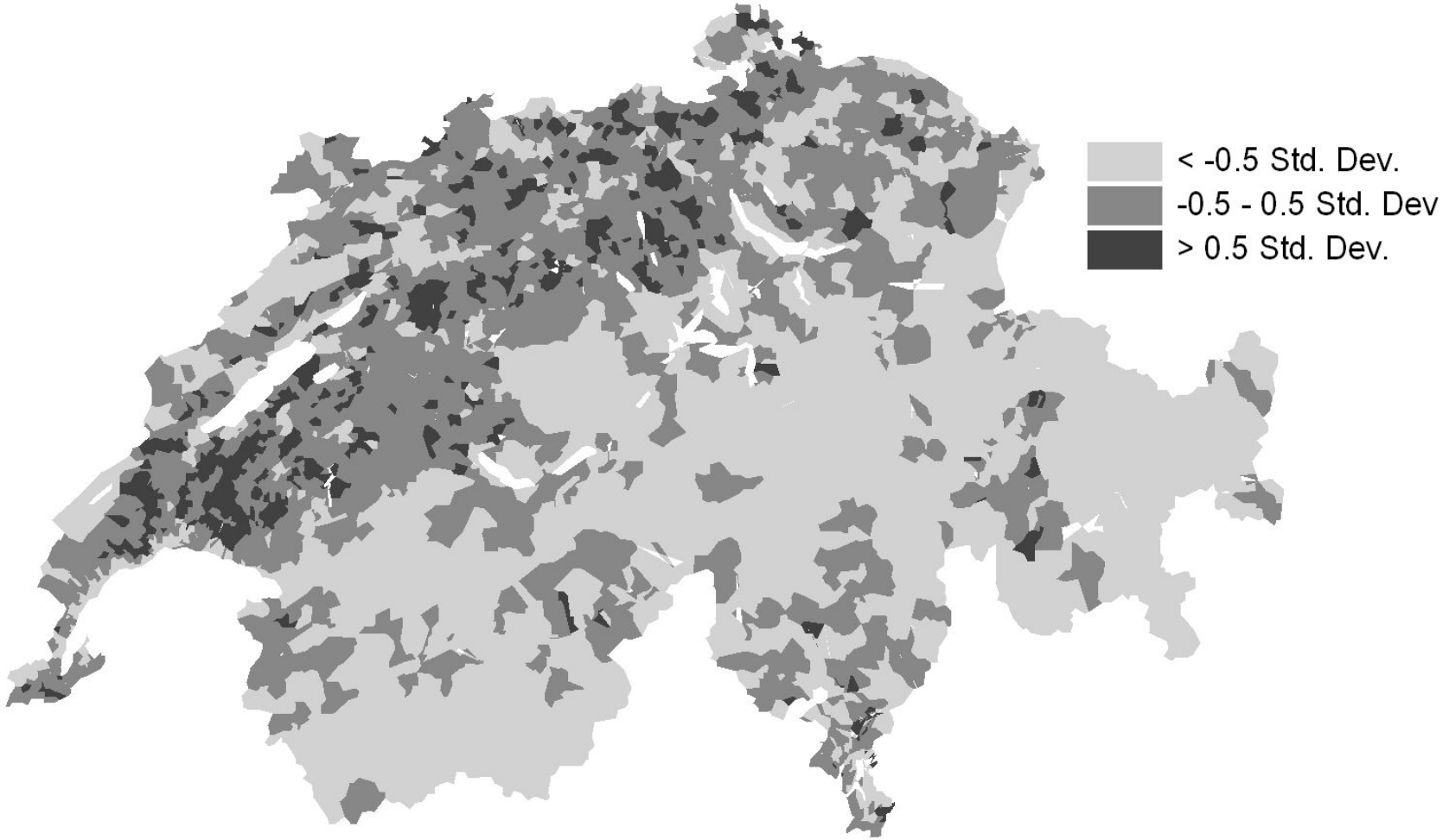


Ratio of road-based accessibility 2000 to 1950



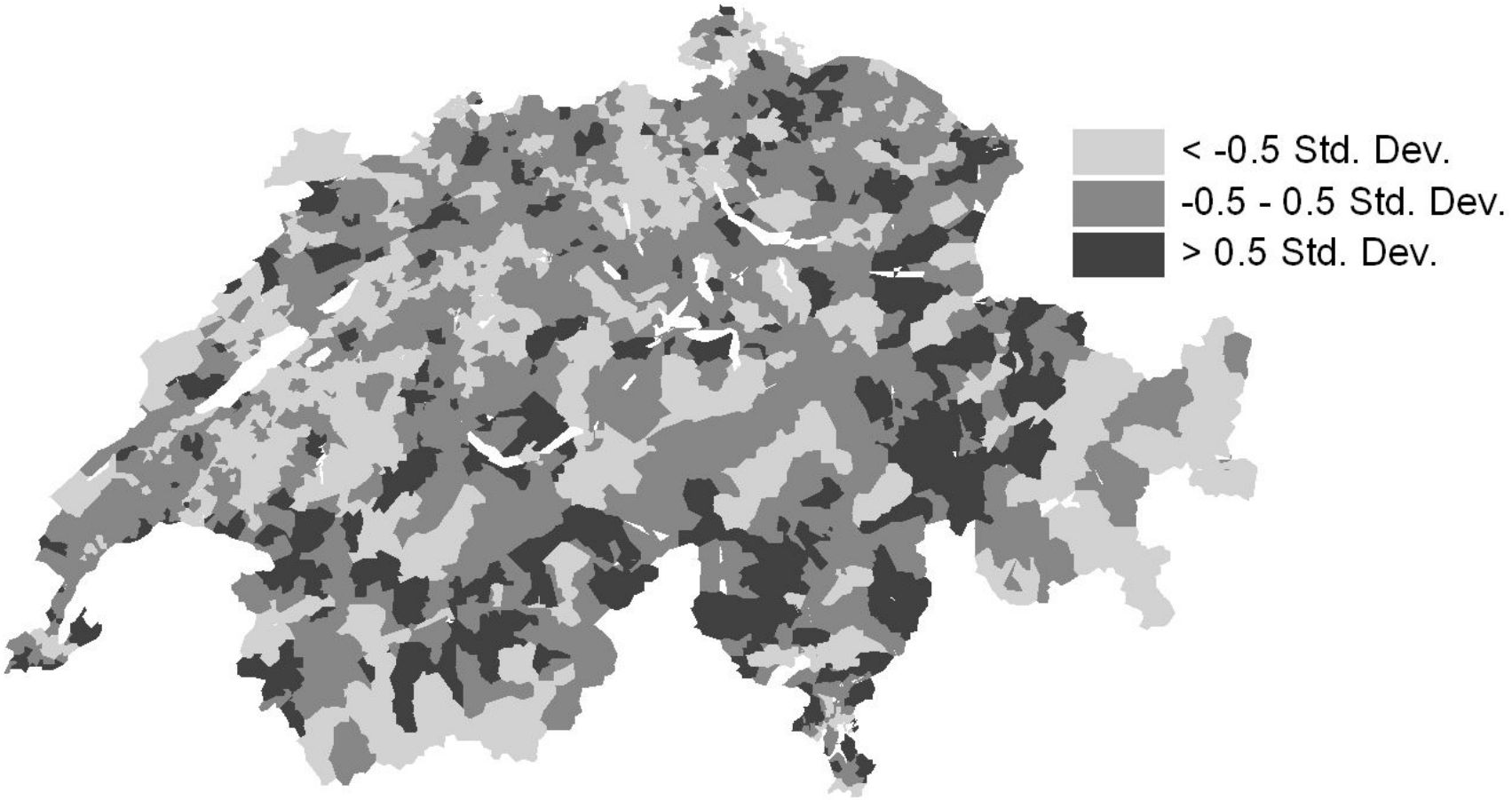
Parameters: Min = 0.22; - 0.5 Std. Deviation = 1.47; Mean = 1.97; + 0.5 Std. Deviation = 2.47; Max = 24.29)

Ratio road to public transport-based accessibility 2000



Parameters: Min = 0.069; - 0.5 Std. Deviation = 2.14; Mean=4.99;
+ 0.5 Std. Deviation = 7.857; Max = 70.55

Ration of road-based accessibility UE to M2 for 2000



Parameters: Min = 0.64; - 0.5 Std. Deviation = 1.64; Mean=1.97;
+ 0.5 Std. Deviation = 2.31; Max = 7.375

Conclusions

Tracking the road-based accessibility changes is possible over a long period of time.

It seems advisable to concentrate only on the developments of the motorways and similar high capacity roads.

A population of 70’000 seems to be a reasonable maximum for a zone.

Public transport results require a full time table.

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Appendix

Network length and cumulative inflation-corrected costs of the Swiss federal road network