Preferred citation style for this presentation

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Measuring the spatial reach of persons, cities or organisations

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ETH
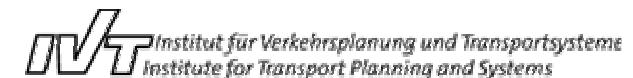
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

How to measure spatial reach ?

Question:

What area, footprint etc. is used by
an organisation, person or city ?

- Person: Activity space
- Network: Geography of its anchors; activity space
- City: Catchment area
- Organisation: Market

Structure

Part 1: Survey design

- Items
- Choice of instrument
- Sample design
- Survey protocol

Part 2: Measurement

Items

Biography (every year, every five years, for every decade ?):

- Household structure and dependents
- Locations (Home, work, regular destinations)
- Mobility tools (licence, car, cycle, season ticket)
- Preferred mode (to work)
- VMT or other measure of travel intensity
- Holidays (locations, duration, group)
- Leisure implements (second homes, boat, horse, camper, allotment etc.)
- Commitments (active memberships; private commitments)
- Income

Items

Contacts (for every year …. ?)

- Name
- Location
- Relationship (Type of first contact)
- Intensity of contact
- Preferred medium of contact
- Typical location of face-to-face meetings
- Special joint activities and their locations
- Linkage to other contacts (awareness of third contacts)

Choice of instrument

- Face-to-face interview

- Written survey

- Historical sources
  - Diaries
  - Letters
  - Photo albums
  - Telephone bills, credit card records, income tax returns

Sample design

Subject:

- Individual and egocentric networks

- Networks
    - Voluntary snowball sampling (difficult, if hypotheses true)
    - Network tracing (Is it ethical ?)
    - Milieux sampling (How far can we rely on peripheral informants ?)

Survey protocol: Face-to-face interviews

Location: Is there an alternative to the respondent's home ?

Duration: Is 2-3 hours enough ?

Incentive: Yes, but what amount ?

Return visit: No, but

Full enumeration of contacts ?

Treatment of less important, but local contacts

First experiences

RA: student intern with a mixed sociology and transport
   background (T. Ohnmacht)

Recruitment: Public notices; more female interest

Sample: Individuals (20-30 years and 60 plus years);

Incentive: 75 sFr

Duration: 2-3 hours with interview guide and life course calendar

No full enumeration; concentration on important contacts

Aim: 8 interviews and working paper (8 week duration)

First experiences: Life course calendar (1)

LEBENSVERLAUFSKALENDER(1/2)	19__			
Ereignisse der Biographie: z.B. Schule(1), Ausbildung(2), Studium(3) Arbeit(4), sonstige Lebensphasen(5).				
ANGABEN ZU DEN WOHNORTEN				
Angaben zu den sozialen Kontakten: (Verwandte, Freunde, Verein, Hobby, Beruf … Namen + Wohnort/Treffpunkt + Verkehrswerkzeug)				

First experiences: Life course calendar (2)

Verfügbarkeit von Personenwagen	//	//	//	//
Verfügbarkeit: 1 = immer / 2 = häufig / 3 = selten / 4 = nie				
Besitz von ÖV-Abonnementen	//	//	//	//
Generalabonnement				
Halbtaxabonnement				
Jahres-, Monats- oder Wochenabonnement				
Ort des Ausbildungs-, Arbeitsplatzes				
Am meisten genutztes Verkehrsmittel zu dieser Zeit.	//	//	//	//
Auto, Töff, Töffli				
Öffentlicher Verkehr (Eisenbahn, Bus, Tram)				
Velo fahren				
Zu Fuss gehen				
Monatliches Brutto-Einkommen	//	//	//	//
0 CHF bis 499 CHF				
500 CHF bis 999 CHF				
1`000 CHF bis 1999 CHF				
2'000 CHF bis 5'999 CHF				
6'000 CHF bis 9'999 CHF				
10'000 CHF bis 13'999 CHF				
14'000 CHF und mehr				

Resulting data

Crosssections:

- Configuration at each time point (persons at locations)

Longitudional

- Accumulated experiences

Episodes:

- Friendships, marriages
- Commitments
- Locations
- Mobility tools

Measurement problem

Transforming information about points of

- Contact
- Origin/destination
- Sale or use

into uni- or lowdimensional measures to allow

- Comparison over time
- Comparison across units

Example: Destinations visited over 6 week period

Home

Work place
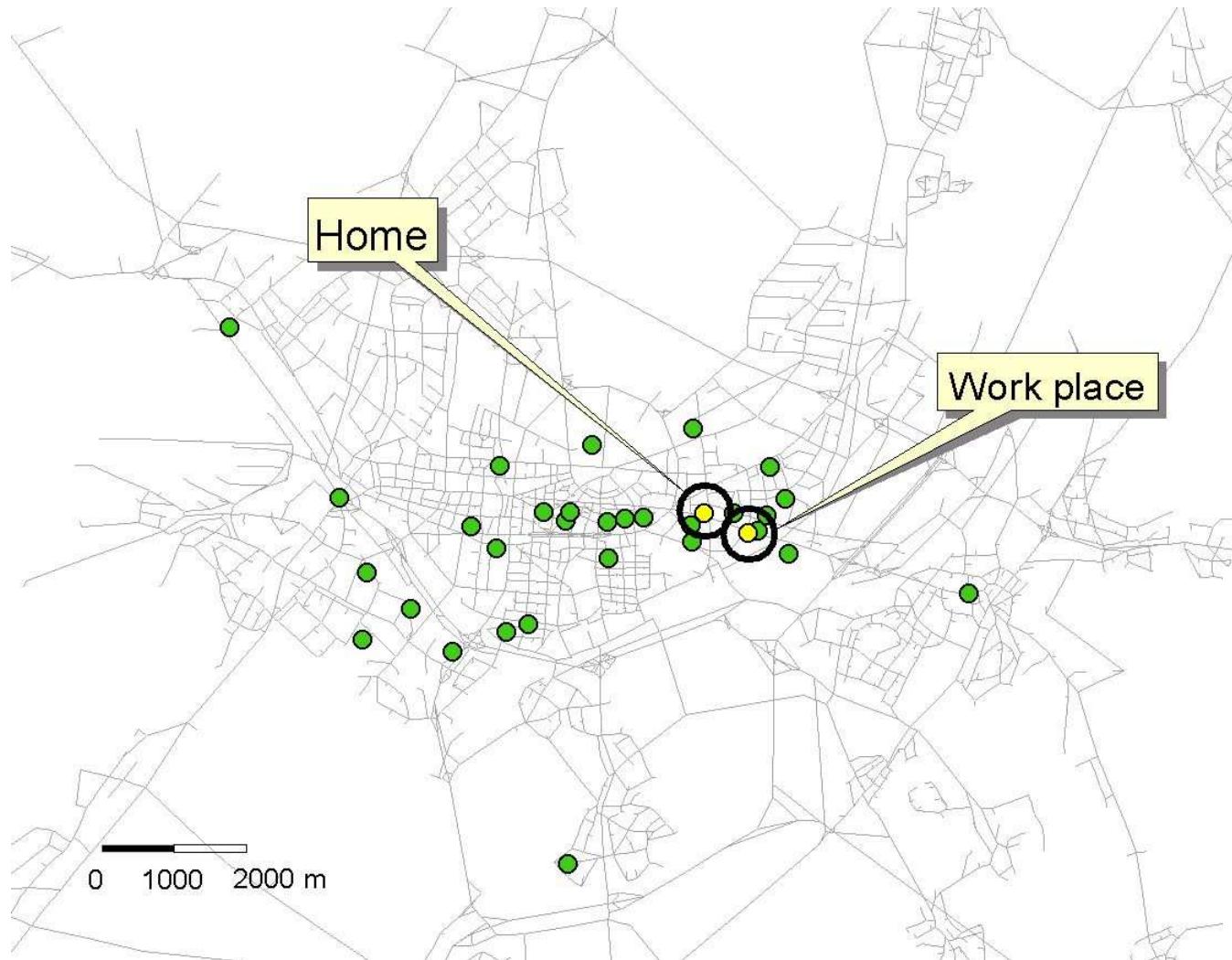
Women, 24

Full-time

Single

216 trips / 6 weeks

0   1000   2000 m

12000761

Example: Destinations visited over 6 week period

Home

Work place

0   1000   2000 m

Man, 50

Full-time

1 child

120 trips / 6 weeks

1201051

Example: Origins of commuters to Zürich (2000)

Einpendleroberzentren2k_zürich.
- 1 - 99
- 100 - 249
- 250 - 499
- 500 - 749
- 750 - 999
- 1000 - 10000
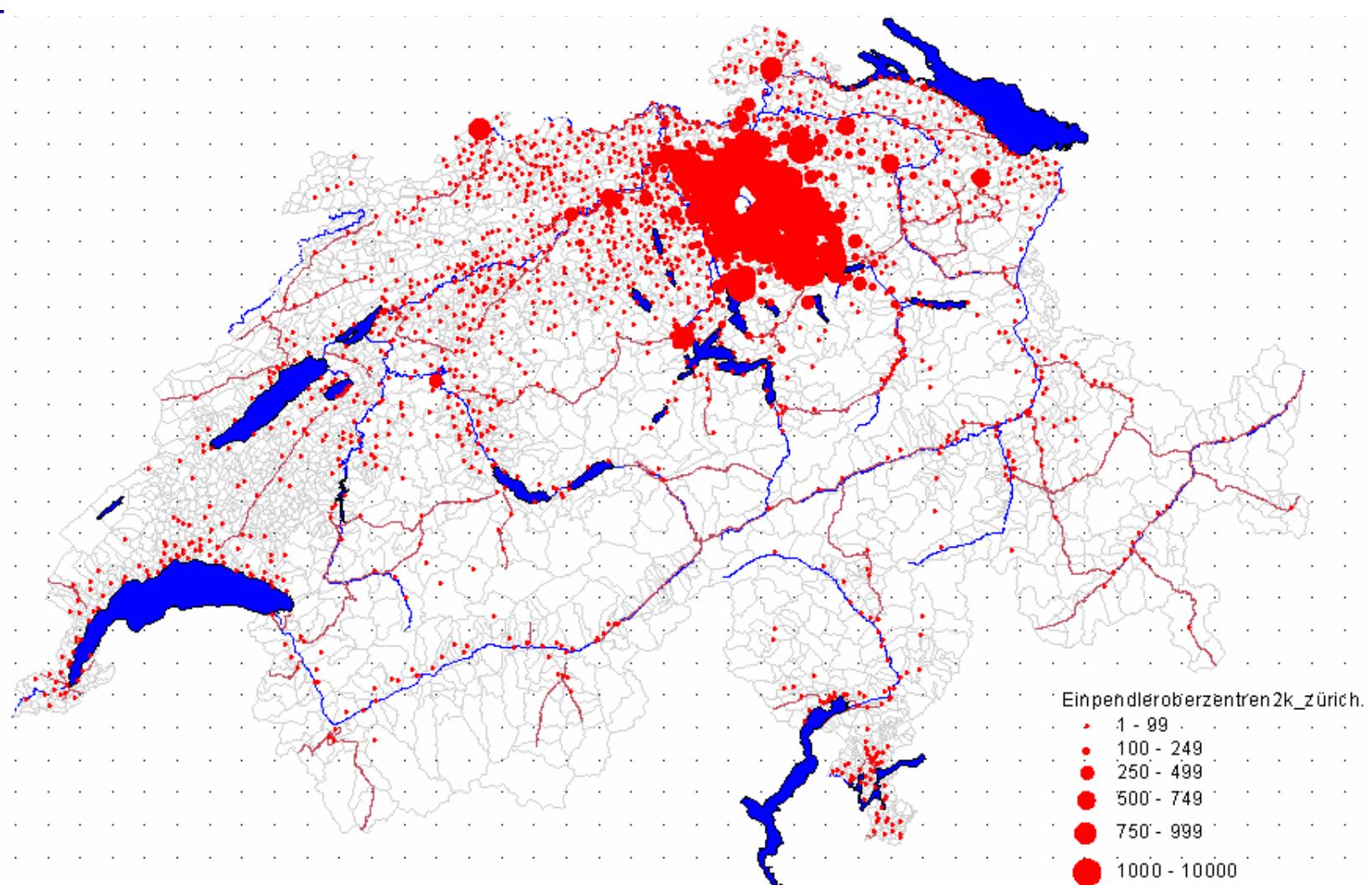
Approaches

Parametric:

- 95% Confidence ellipse

Non-parametric:

- Kernel-density estimates (using a specific Kernel-density function)

- Shortest-path networks

- [Chosen-path networks]

Approach 1: 95% Confidence ellipse
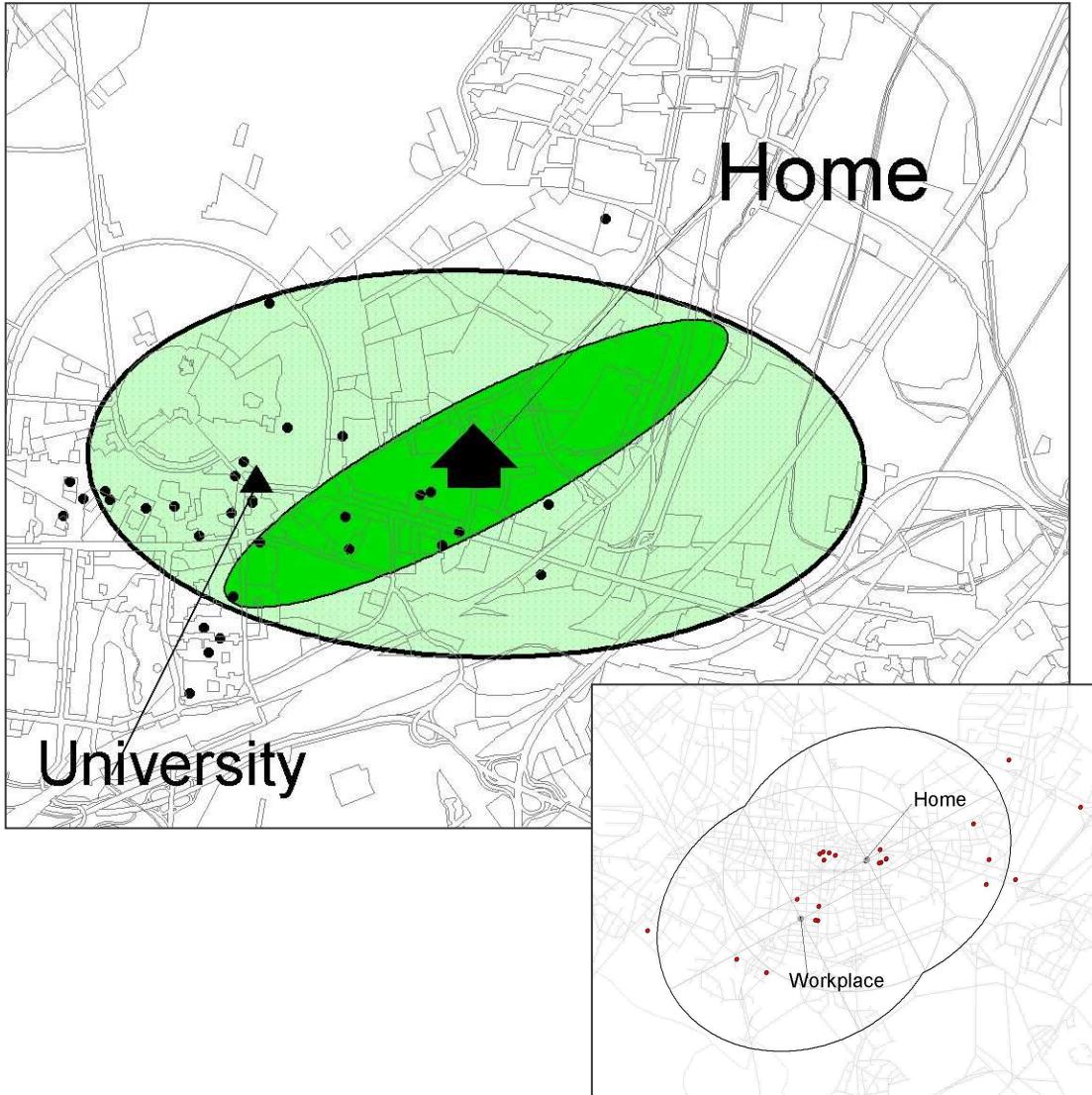
Smallest possible area of a true value of the population (i.e. activity locations)

Measure: Area

Focus: Spread of locations

Example: Zürich's commuter shed 2000
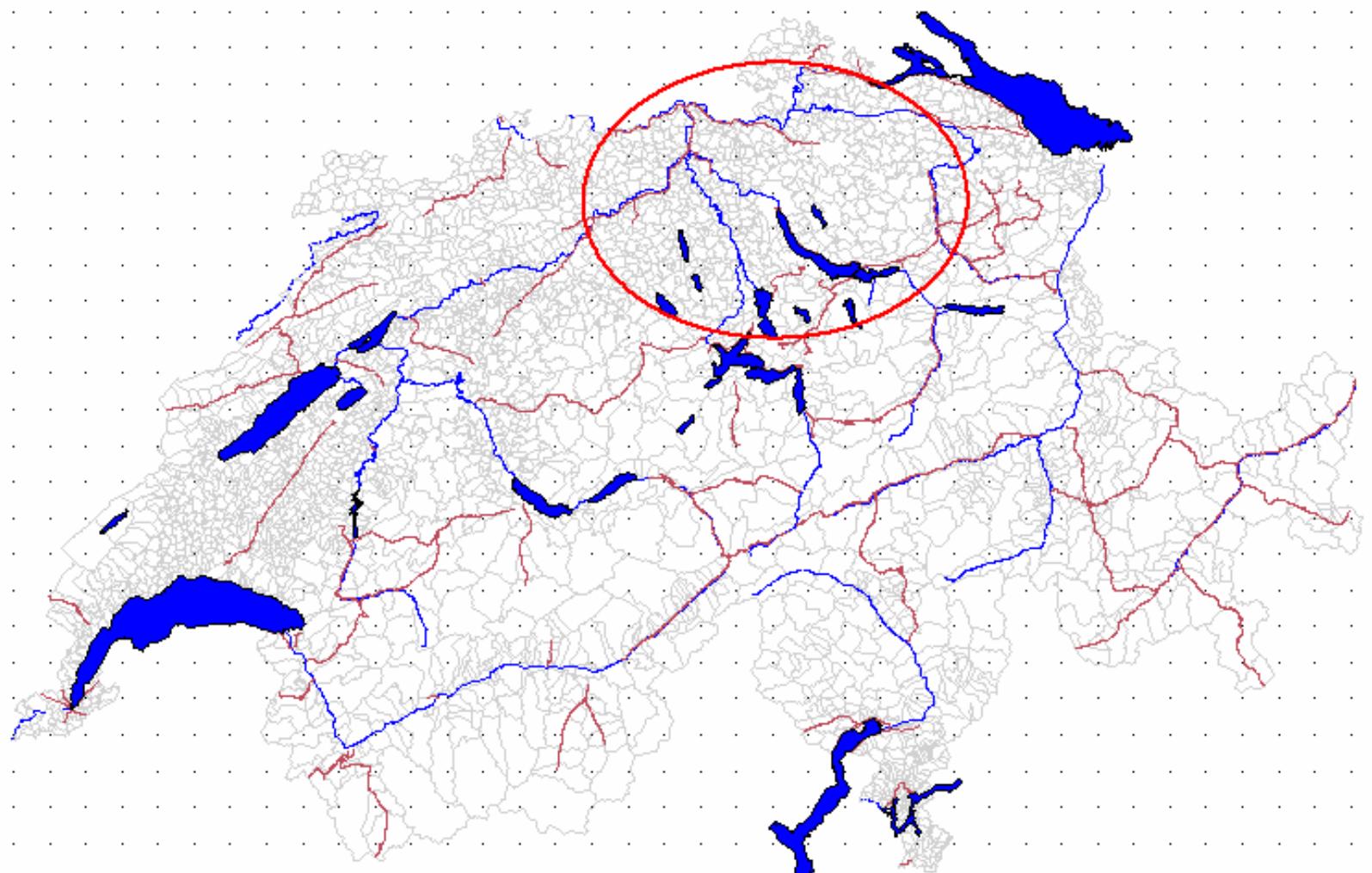
Approach 2: Kernel densities

Density surface created by distribution of locations weighted by frequency of visit

Measure: Area with positive density value

Focus: Clustering

Example: Zürich's commuter shed 2000

Density from Einpendlerobe rz...
Mean
0.0 - 0.5 Std. Dev.
0.5 - 1.0 Std. Dev.
1.0 - 1.5 Std. Dev.
1.5 - 2.0 Std. Dev.
2.0 - 2.5 Std. Dev.
2.5 - 3.0 Std. Dev.
> 3 Std. Dev.
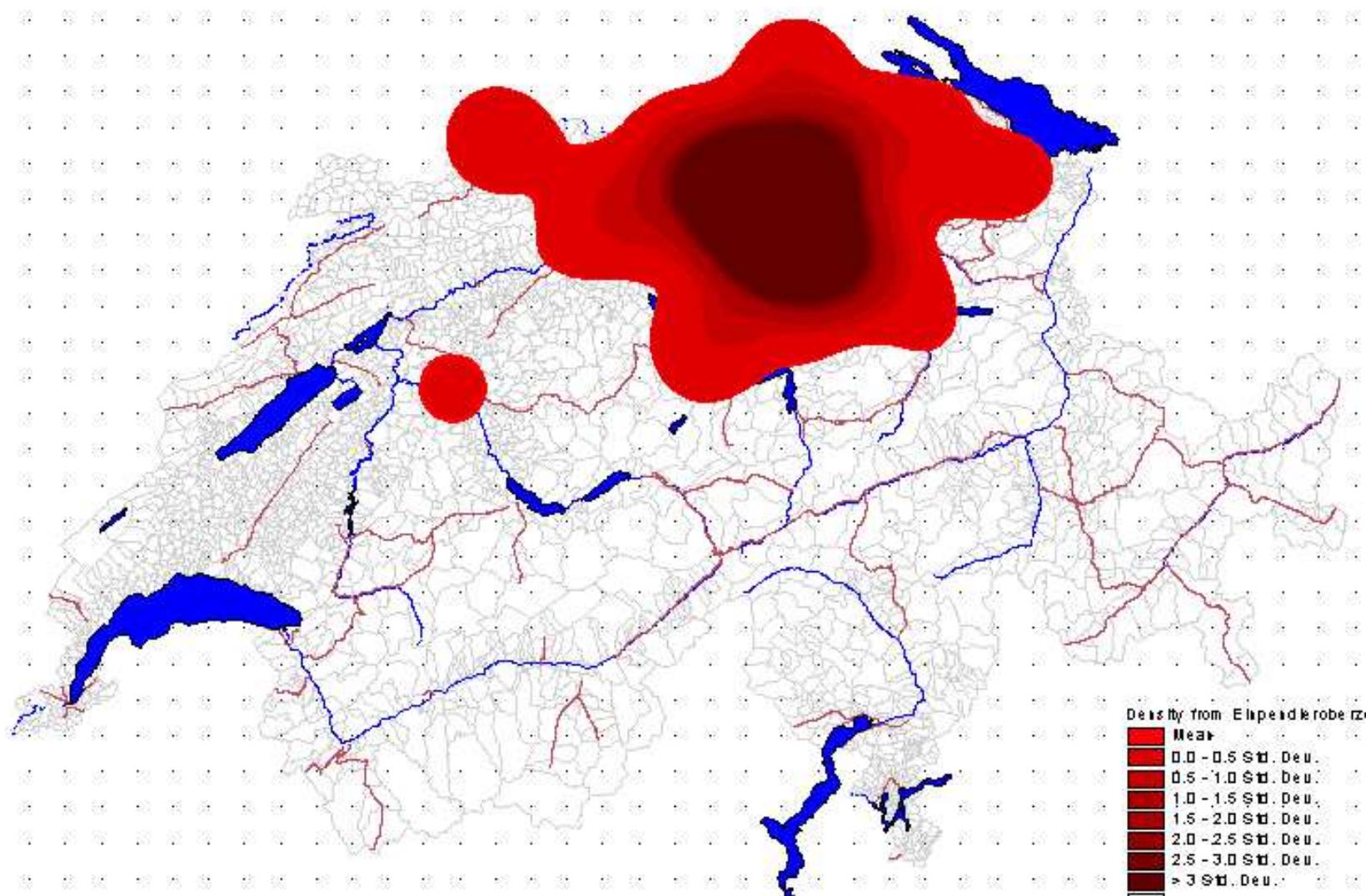
Approach 3: Shortest path network
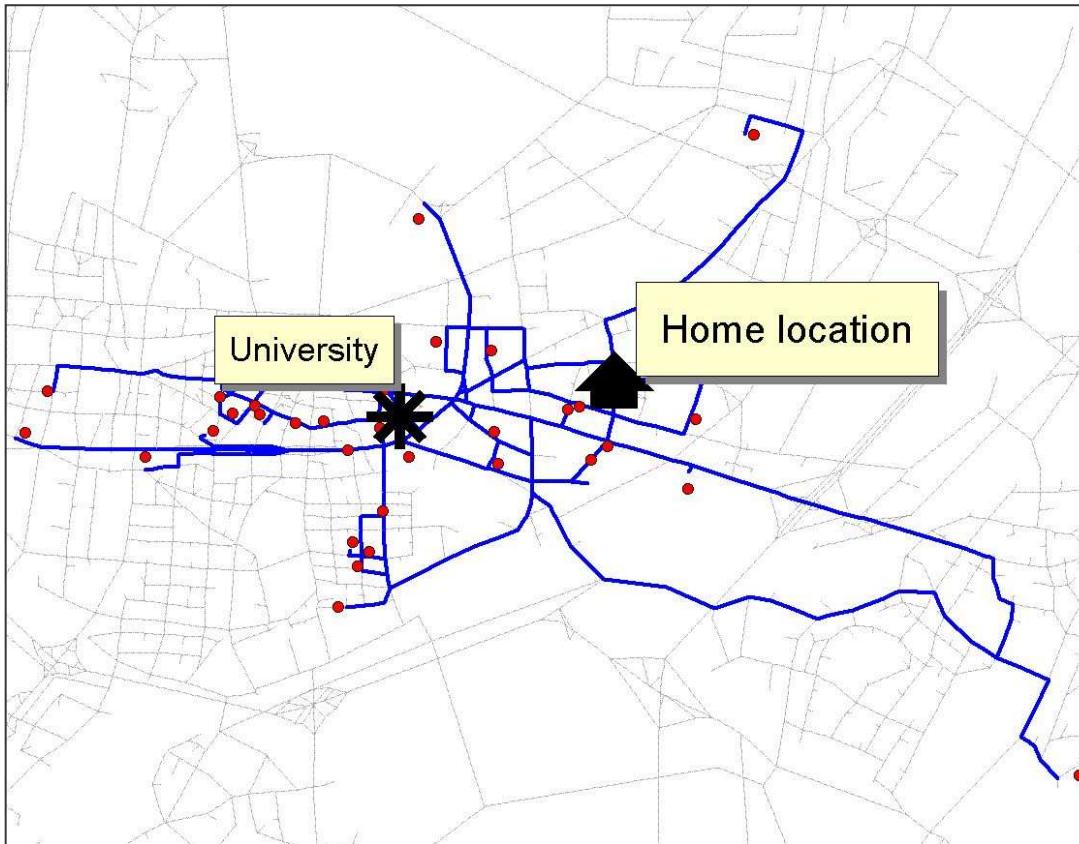
Smallest geometry based on all O-D-relations observed (e.g. shortest paths)

Measure: Length of geometry / area spanned / buffered area

Focus: Spread of locations

Obvious refinements

All:

- Segmentation by type of interaction; time period
- Appropriate weighting schemes (In ?)

Confidence ellipse, Kernel densities:

- Removal of a-priori excluded spaces

Shortest path networks:

- Use mode-specific networks
- Use stochastic assignment

Refinement: Exclusion of excluded areas
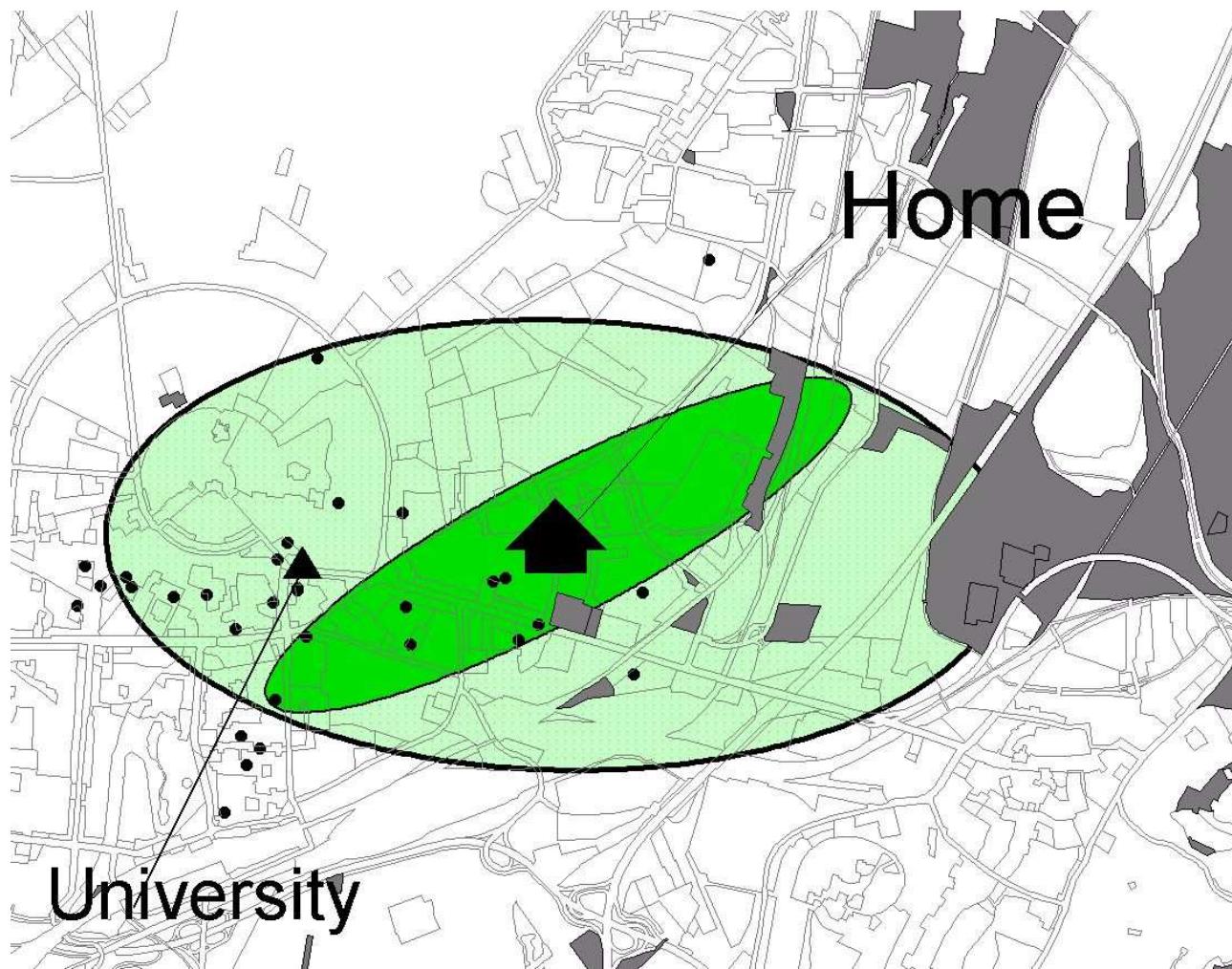
Additional information

Confidence ellipse:

- Angle of the main axis relative to reference point
- Mean vector between point of interaction and base

Kernel densities:

- Number of contiguous areas (clusters)

Shortest path networks:

- All descriptive statistics for network graphs
- Flow estimates

Additional information: Flow estimates
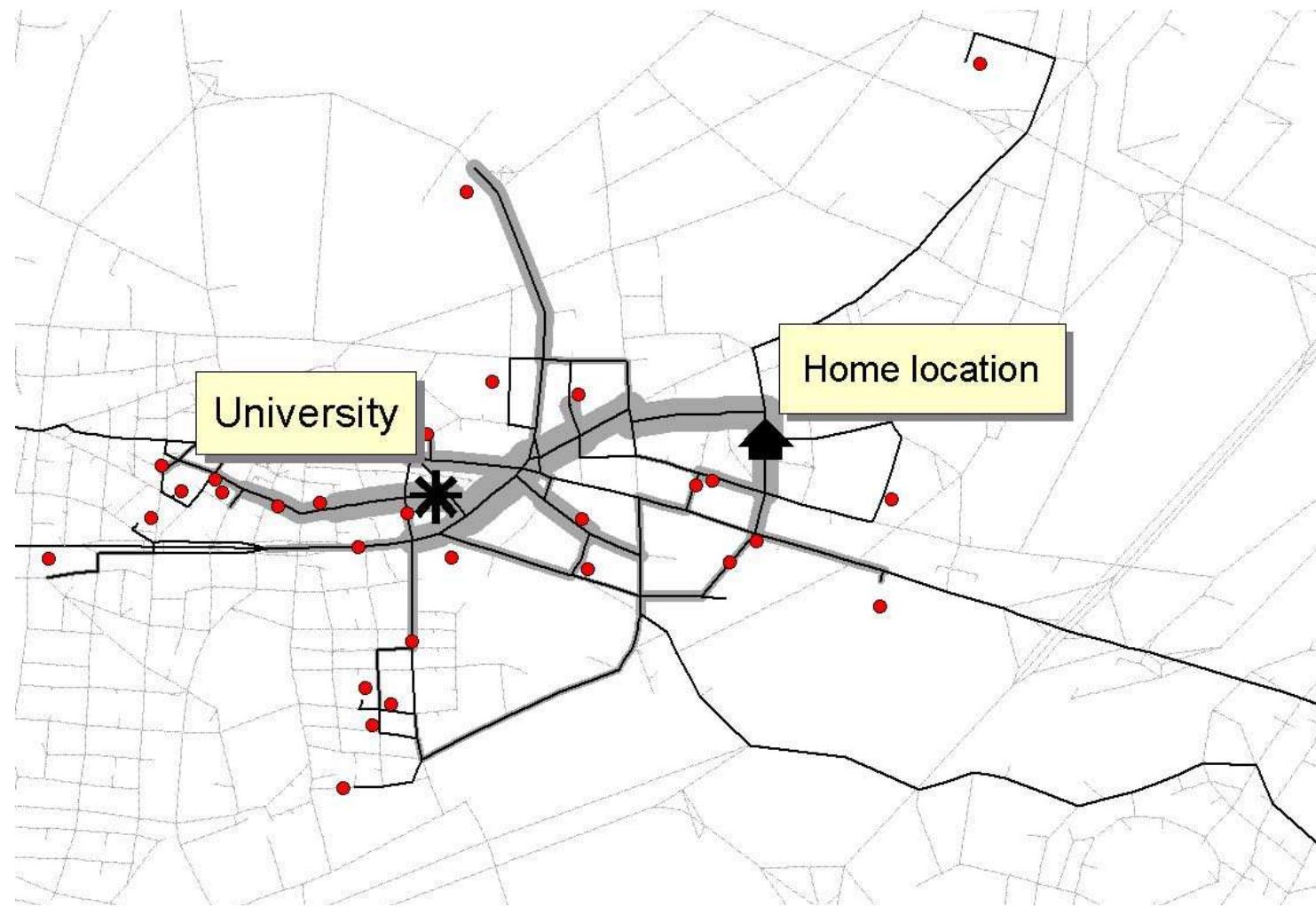
# Activity space size variation: 95% CE*
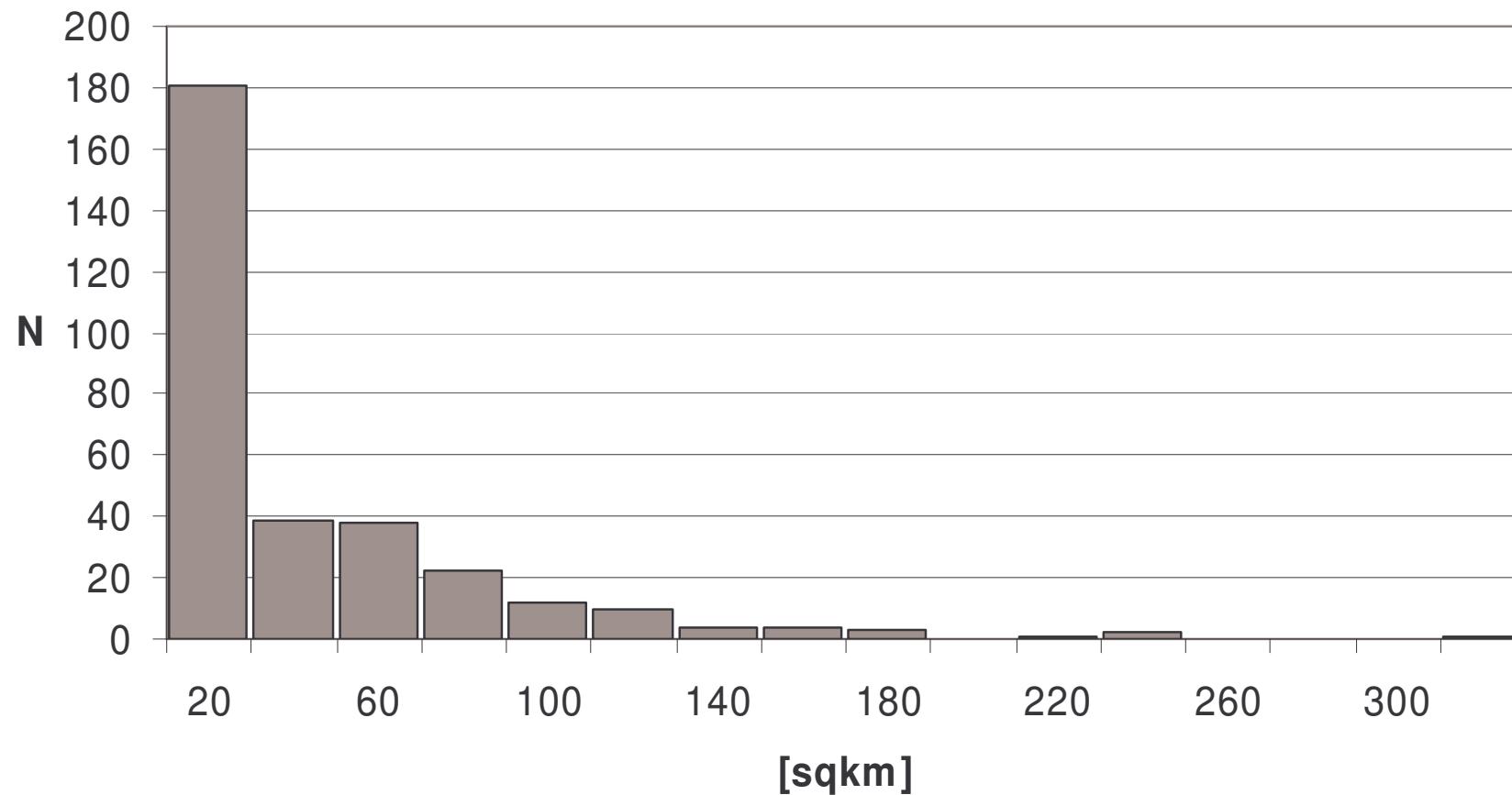
* Local trips only

Activity space size variation: Kernel densities*
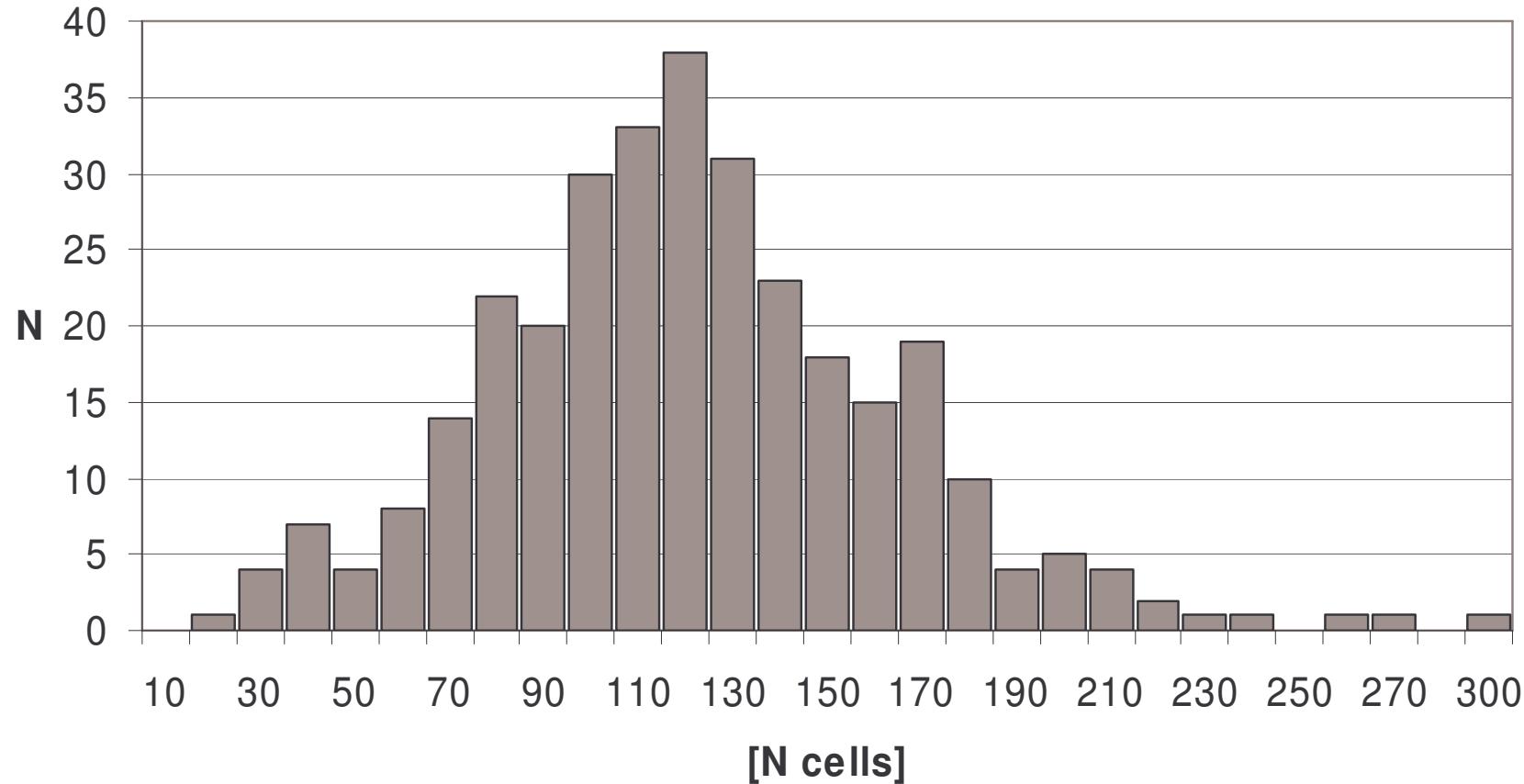
* "Visited area", grid cells with positive Kernel densities value
    [500*500m]; local trips only

Activity space size variation: Shortest path networks*
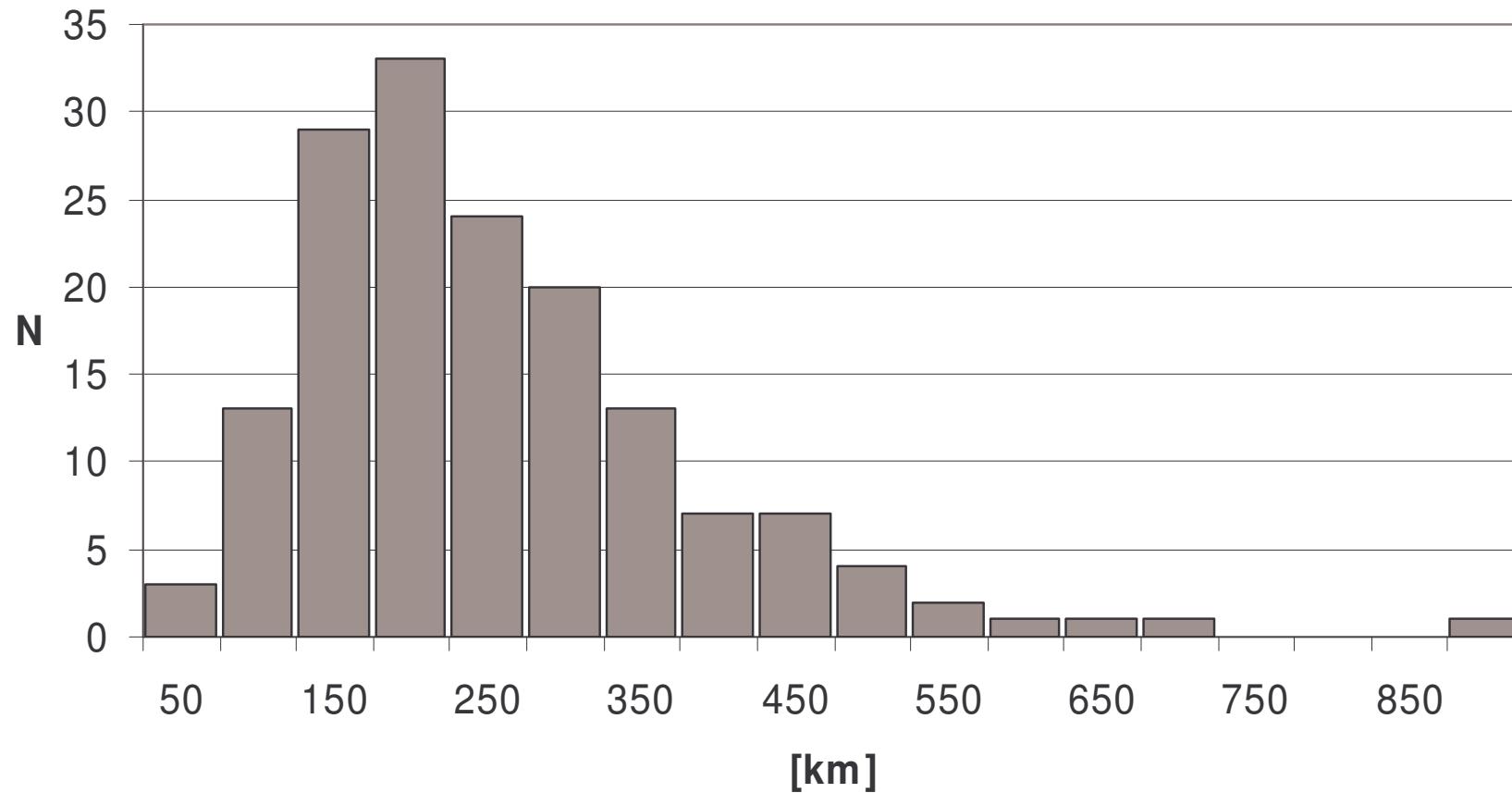
* Minimum network based on observed local O-D-relations

Number of clusters: Mobidrive

Cluster:

- radius: 1000m
- minimum 10% of all trips
- minimum 3 unique locations total
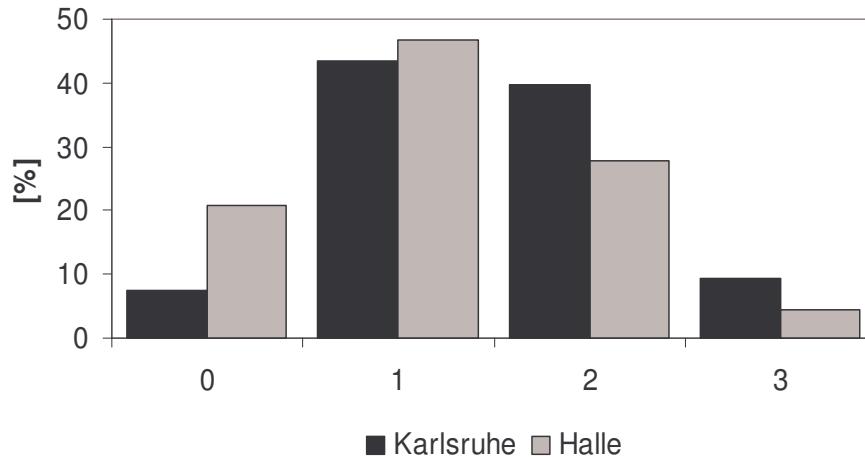
Which purposes as cores?

Workplace as centre nonsignificant?
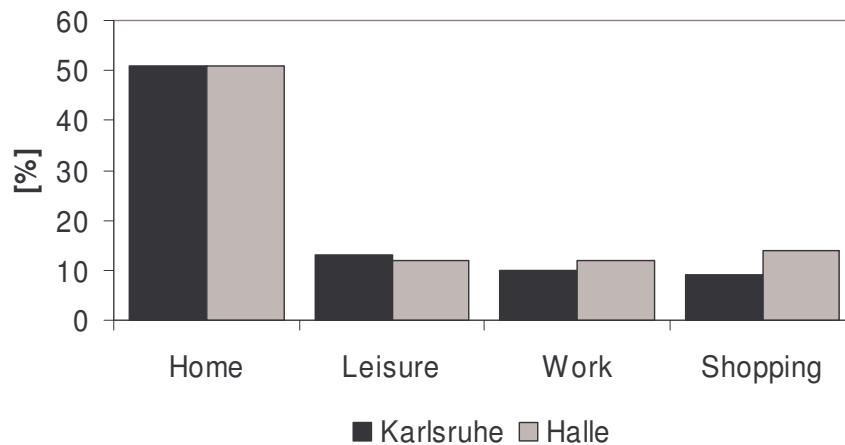
Trends: Swiss commuter sheds since 1970

Legend:
- 1970
- 1980
- 1990
- 2000

Botte
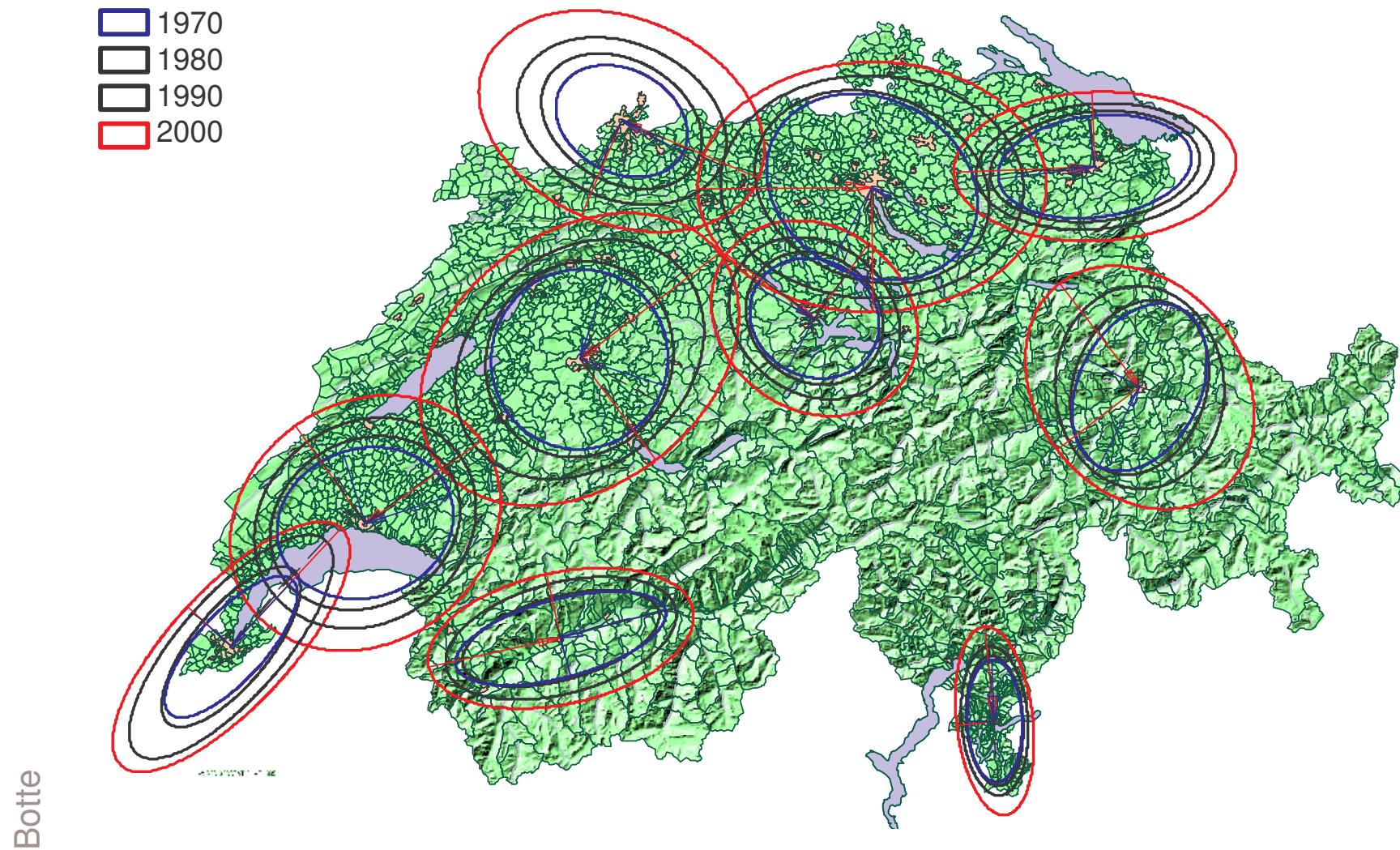
Swiss commuter shed growth1970 – 2000 (95% CE)
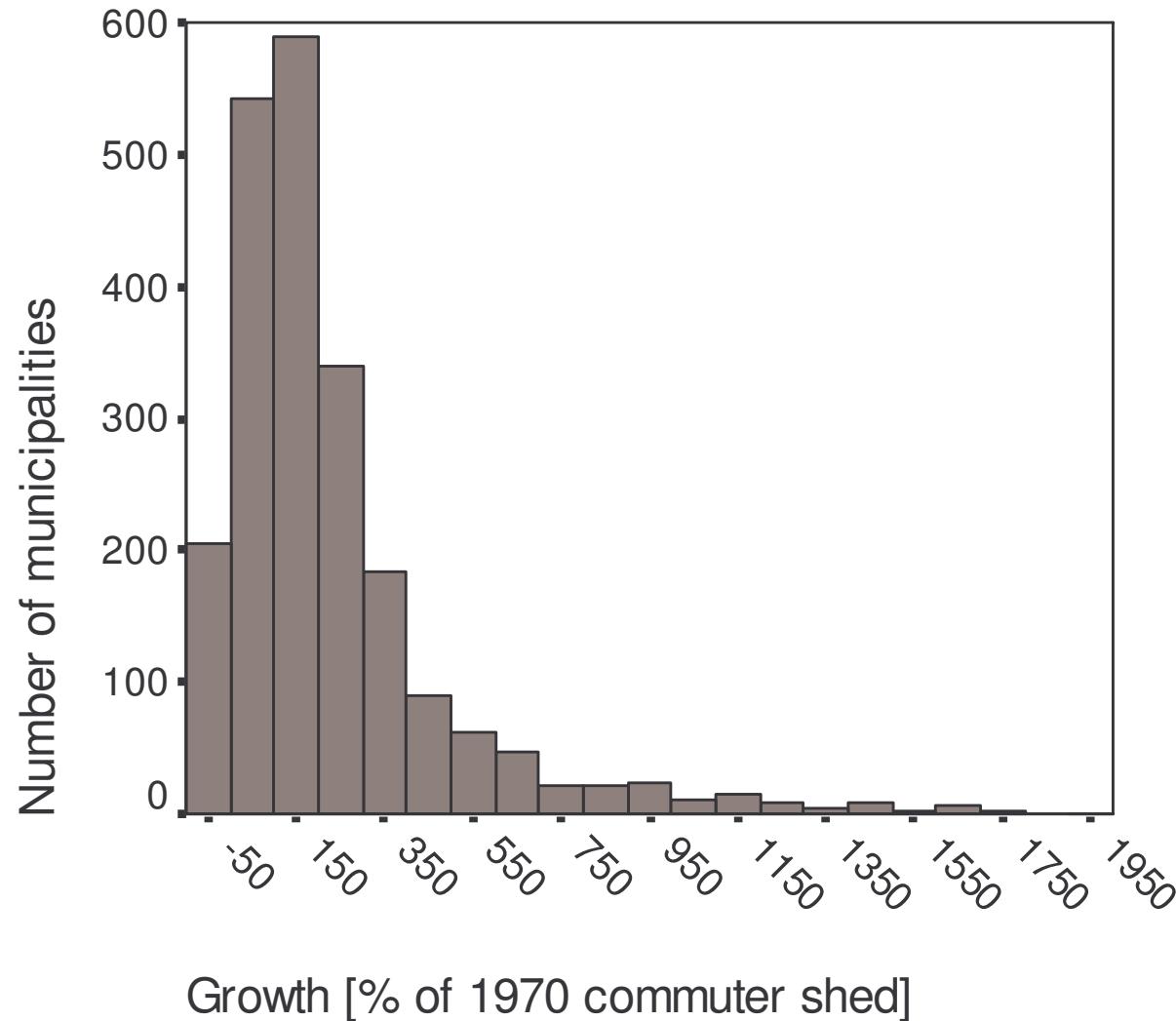
Swiss commuter shed growth1970 – 2000 (95% CE)

Type of municipality:

	Core	Secondary centre	First ring	Second ring
Mayor centre	160	207	371	243
Mid-sized centre	145		239	321
Small centre	141			
„Commuter"	300			
Industrial	298			
Semi-rural	391			
Rural	450			

Advantages and disadvantages

Appraoch	Plus	Minus
Confidence Ellipse	Simple Useful secondary measures	Too rigid Overestimate
Kernel density	Identification of clusters, Follows pattern	Complex calculation
Shortest path network	Travel impacts obvious	Large data needs