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Spatial uncertainty propagation in ICT data analysis

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Spatial uncertainty propagation in ICT data analysis

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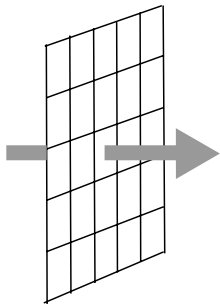
UrbanNet 2016 | Amsterdam

21 September 2016

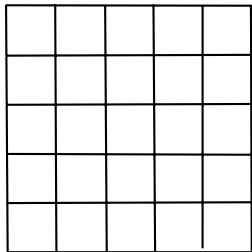


Motivation

"Reality"



Data



Sampling framework

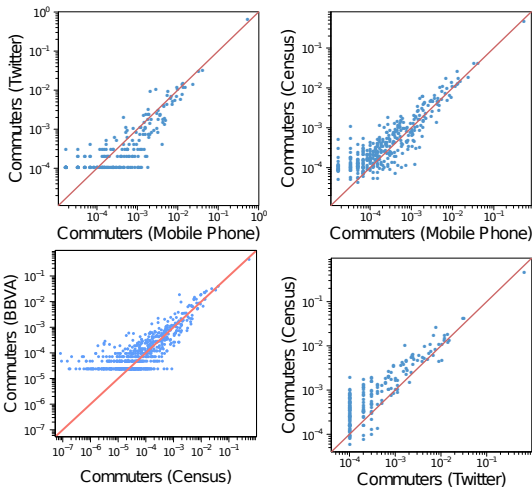
(Spatial) Uncertainty Propagation

- ▶ Example: population size of Netherlands. We may estimate it as 16,800,000 million. Perhaps in reality it is 16,967,234; hence error of -1%
- ▶ Error is usually not know because reality is not know

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- ▶ Error is usually not know because reality is not know
- ▶ Crosschecking information

Crosschecking mobility information



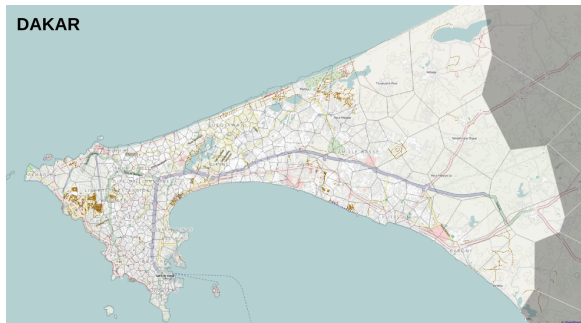
Lenormand et al. (2014) Cross-checking different sources of mobility information. *PlosOne*, 9(8):e105407.

(Spatial) Uncertainty Propagation

- ▶ Example: population size of Netherlands. We may estimate it as 16,800,000 million. Perhaps in reality it is 16,967,234; hence error of -1%
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- ▶ Crosschecking information
- ▶ **Uncertainty propagation analysis**
 - ↳ **Lenormand et al.** (2016) Is spatial information in ICT data reliable?
arXiv preprint arxiv:1609.03375.

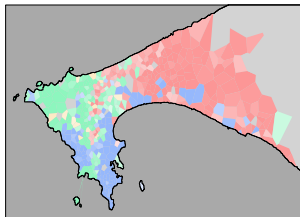
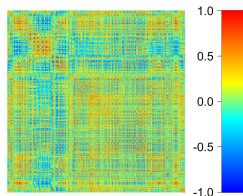
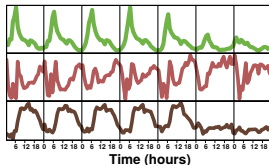
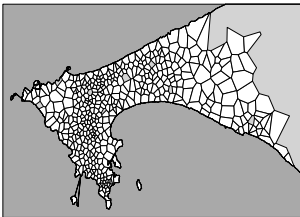
ICT Data uncertainty analysis

300,000 mobile phone users' trajectories x **25** two-week periods



Inferring **land use** and identifying **home-work locations**
from mobile phone activity

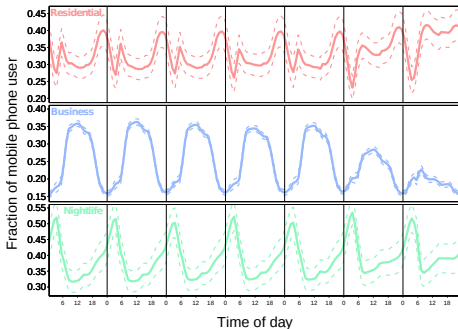
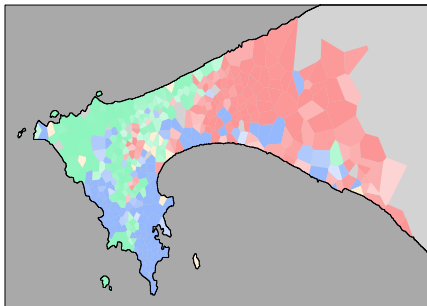
Land use detection



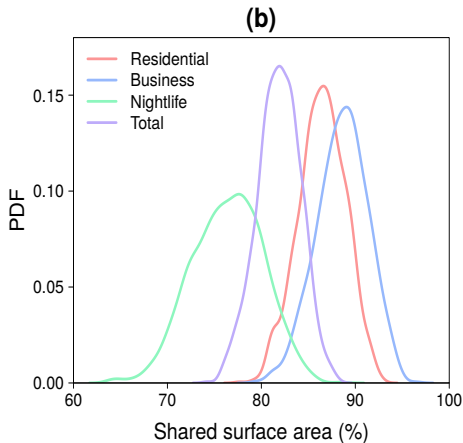
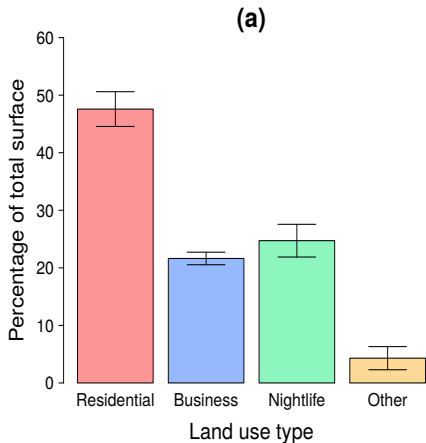
Lenormand *et al.* (2015) Comparing and modeling land use organization in cities. Royal Society Open Science 2, 15052015.

Land use detection

Extraction of 50 independent samples based on 150,000 users activity during on week



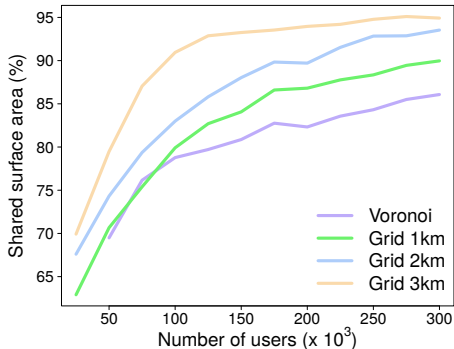
Land use detection



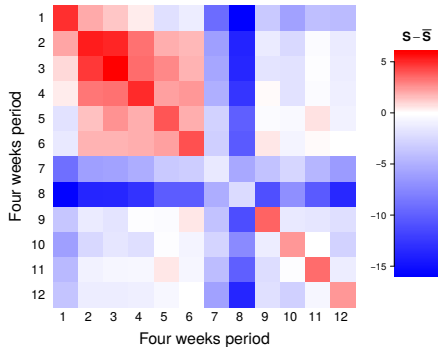
$$SSA(S_l, S'_l) = 2 \frac{A_{S_l \cap S'_l}}{A_{S_l} + A_{S'_l}}$$

Land use detection

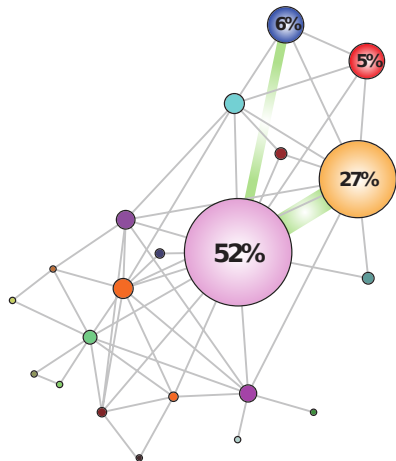
Size & Scale



Time



Most frequented locations



Home

*Most frequented location between
7pm and 7am*

Work

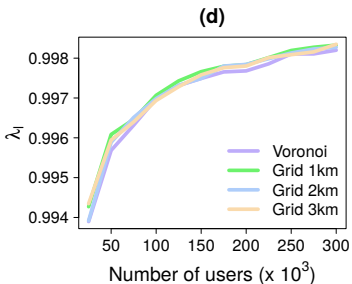
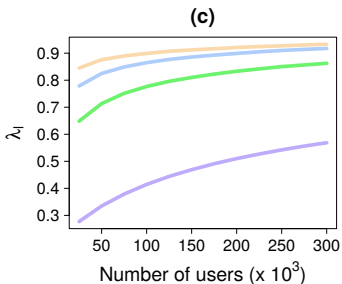
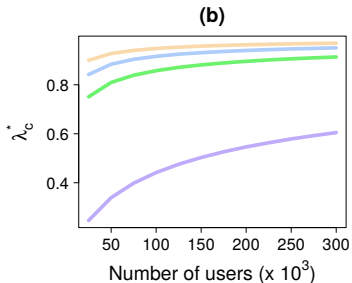
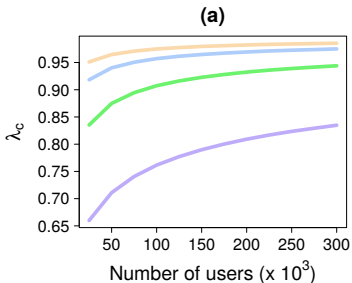
*Most frequented location between
8am and 5pm on weekdays*



Origin-Destination Matrix

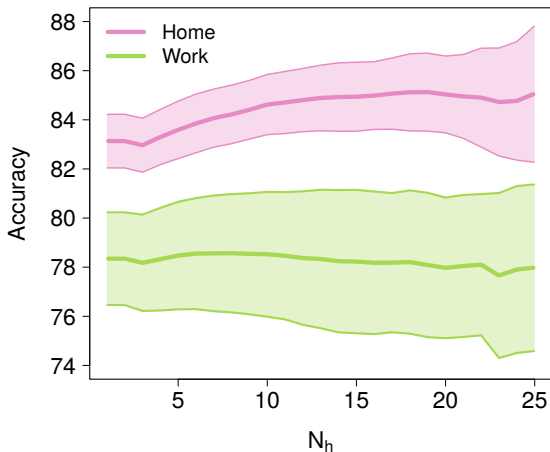
T_{ij}: number of individuals living in
cell ***i*** and working in cell ***j***

Most frequented locations



Most frequented locations

Robustness of home-work locations identified for each user



Take home messages...

- ▶ Good agreement between land uses identified from 100,000 users activity signals, with an average of 75% of shared surface area.
- ▶ Uncertainty on the journey-to-work commuting network is highly dependent of the spatial resolution.
- ▶ More studies in this spirit need to be done to assess the biases and uncertainty associated with this new data sources.

Lenormand et al. (2016) Is spatial information in ICT data reliable?
arXiv preprint arxiv:1609.03375.

Self-promotion

ictdataaccuracy.github.io