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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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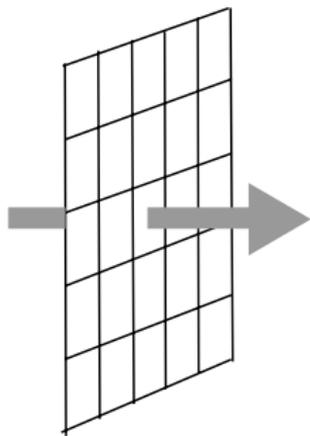
**UrbanNet 2016 | Amsterdam**

*21 September 2016*

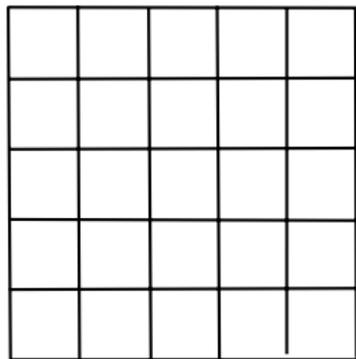


# Motivation

"Reality"



Data



Sampling framework

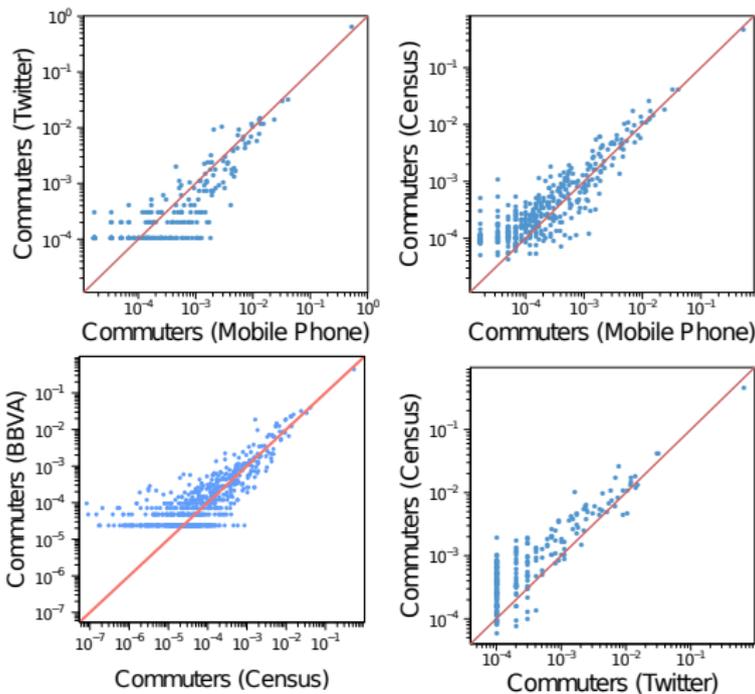
# (Spatial) Uncertainty Propagation

- ▶ 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

# (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
- ▶ Crosschecking information

# Crosschecking mobility information



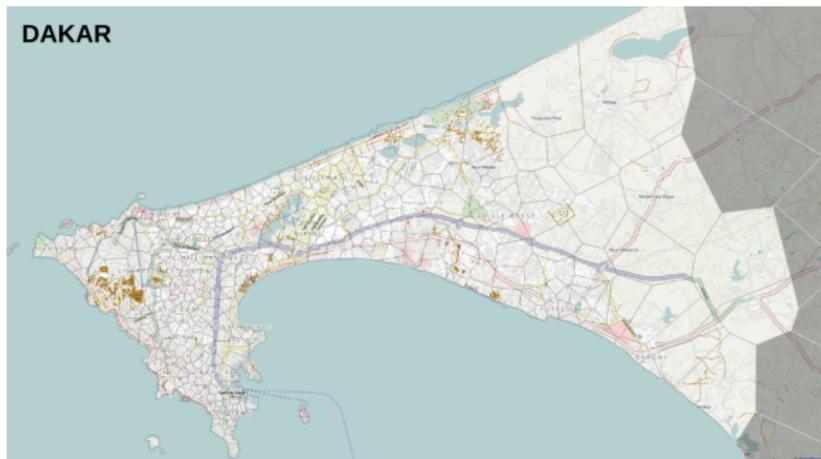
**Lenormand et al.** (2014) Cross-checking different sources of mobility information. *PlosOne*, 9(8):e105407.

# (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%
- ▶ Error is usually not know because reality is not know
- ▶ Crosschecking information
- ▶ **Uncertainty propagation analysis**
  - ↳ **Lenormand et al.** (2016) Is spatial information in ICT data reliable?  
*arXiv preprint arxiv:1609.03375.*

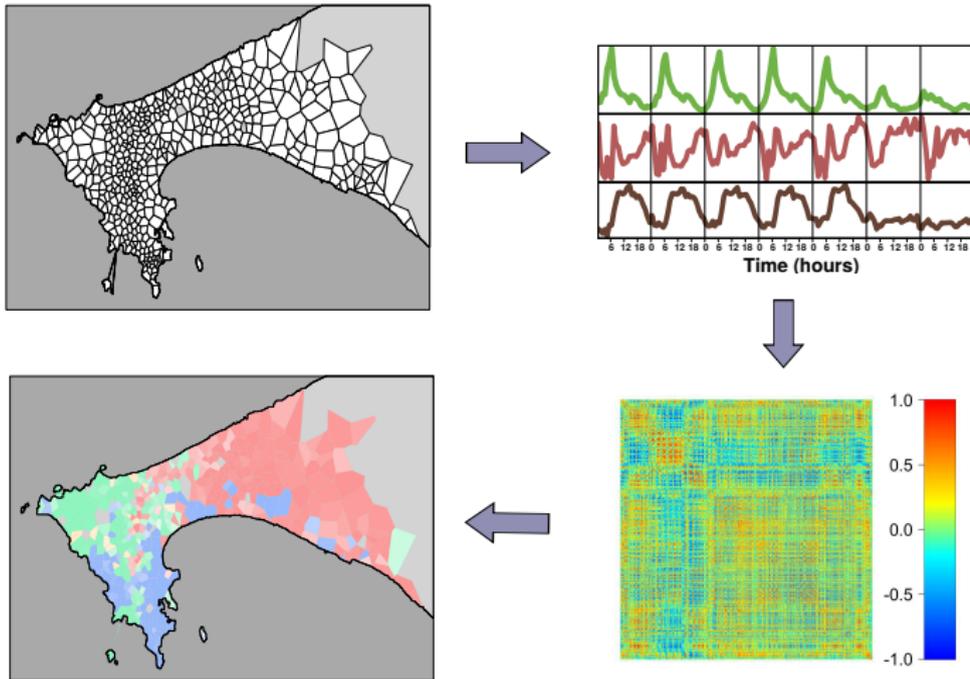
# ICT Data uncertainty analysis

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



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

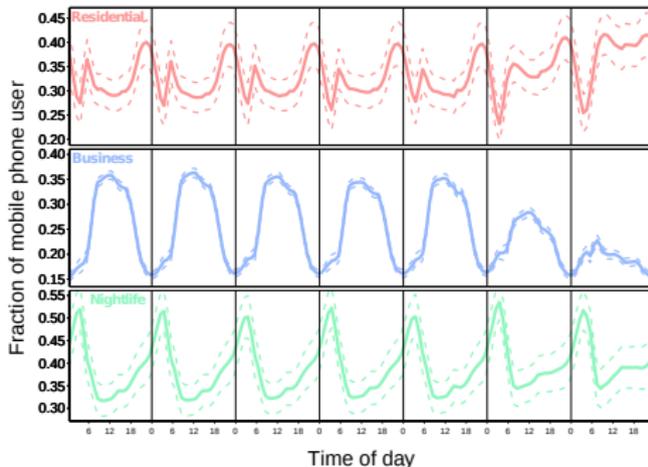
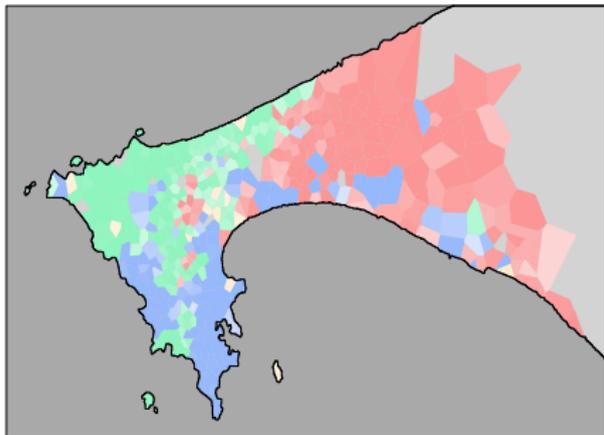
# Land use detection



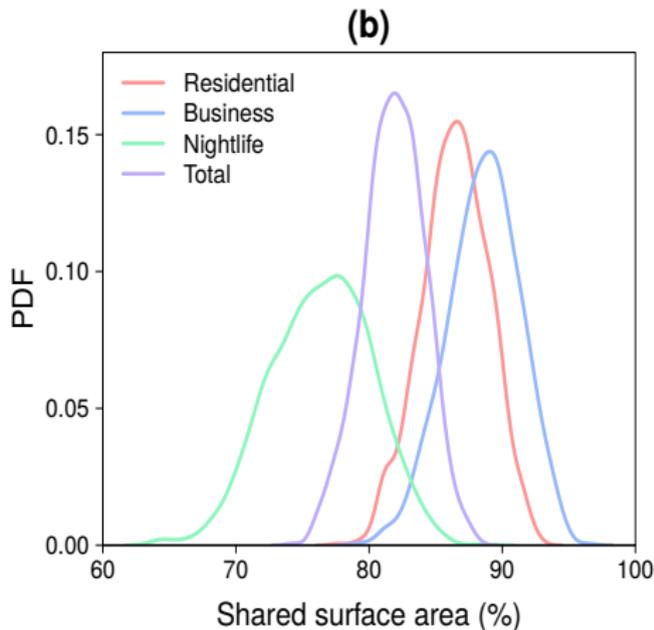
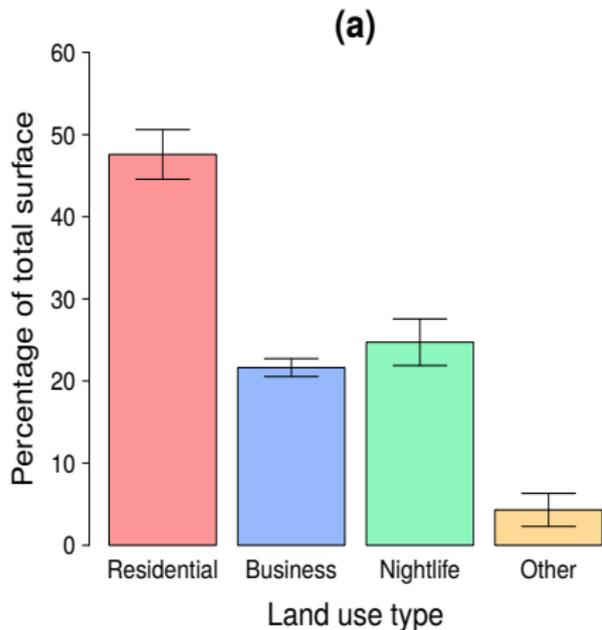
**Lenormand *et al.*** (2015) Comparing and modeling land use organization in cities. Royal Society Open Science 2, 15052015.

# Land use detection

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



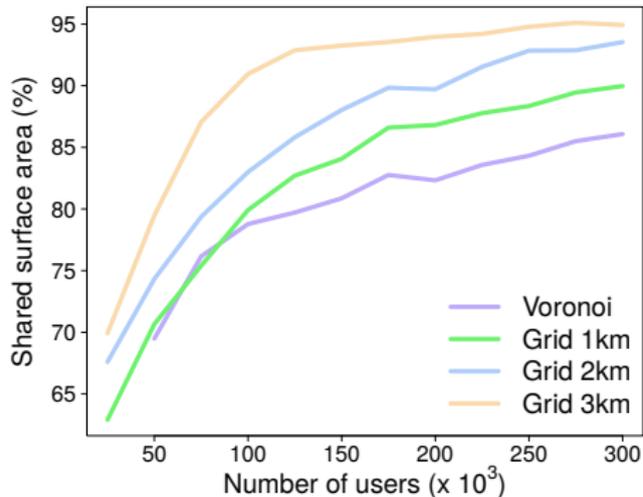
# Land use detection



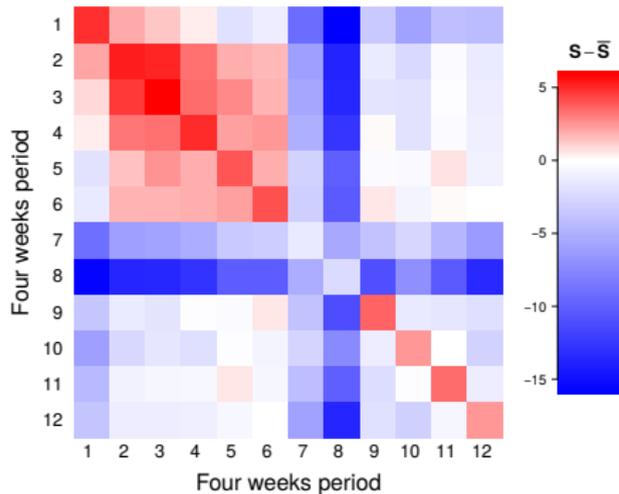
$$SSA(S_l, S'_l) = 2 \frac{A_{S_l \cap S'_l}}{A_{S_l} + A_{S'_l}}$$

# Land use detection

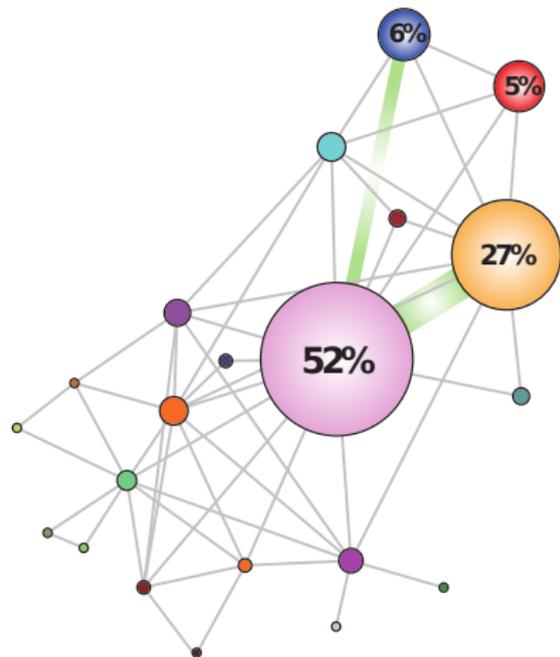
## Size & Scale



## Time



# Most frequented locations



## Home

*Most frequented location between  
7pm and 7am*

## Work

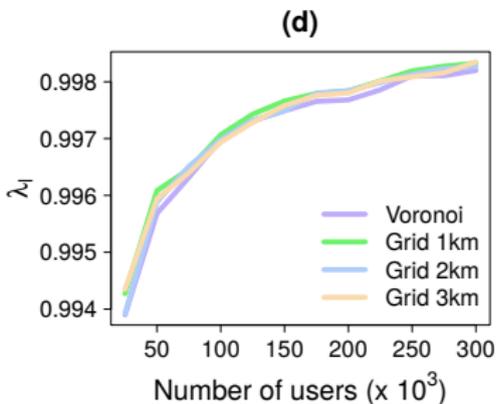
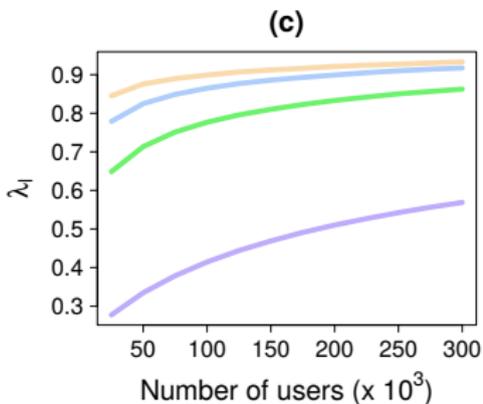
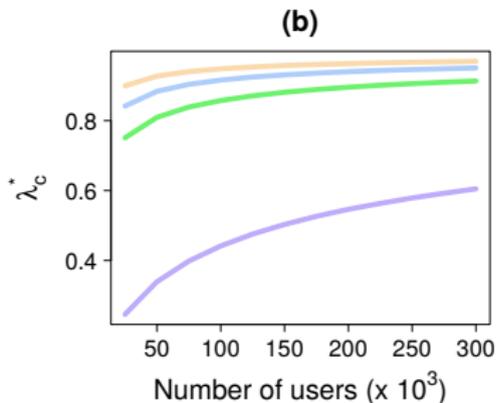
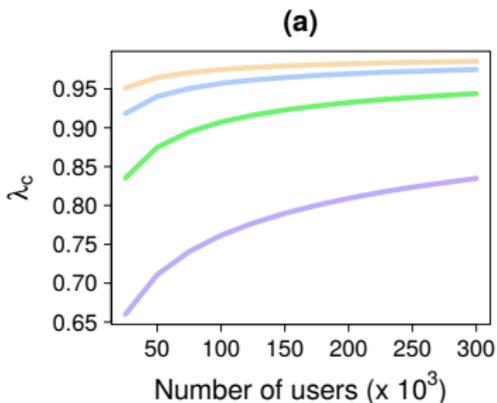
*Most frequented location between  
8am and 5pm on weekdays*



## Origin-Destination Matrix

***T<sub>ij</sub>***: number of individuals living in  
cell ***i*** and working in cell ***j***

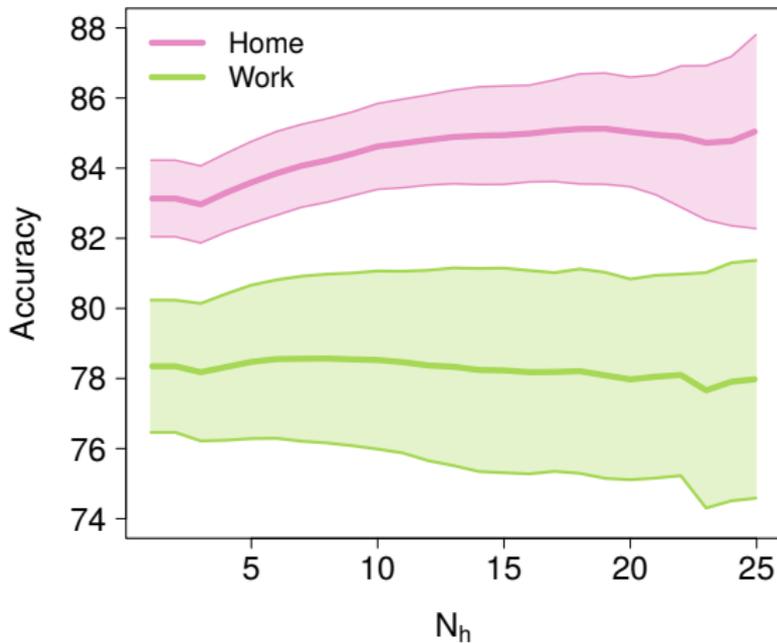
# Most frequented locations





# 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](https://ictdataaccuracy.github.io)