

Desire-based Activity Simulation and Aggregated Traffic Assignment

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JÜLICH SYSTEMS ANALYSIS

Human Mobility and Utility Maximisation

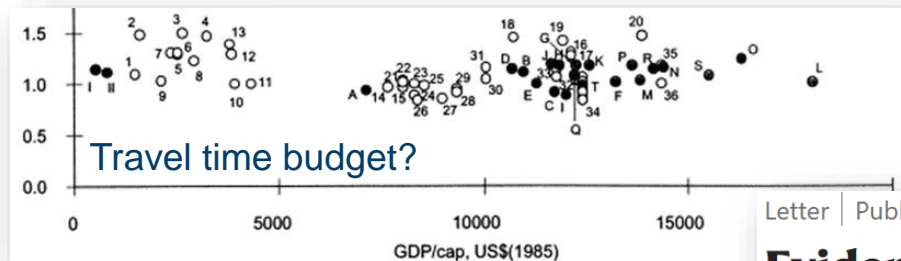
Copernicus: June 2024 marks 12th month of global temperature reaching 1.5°C above pre-industrial

Climate change and within-country inequality: New evidence from a global perspective

Elena Paglialunga , Andrea Coveri , Antonello Zanfei 

**Transport research objectives evolved:
Congestion → Climate change mitigation, accessibility**

The focus of this symposium will be the *Representation of Evolutionary Travel Behavior*.



Letter | Published: 18 June 2018

Evidence for a conserved quantity in human mobility

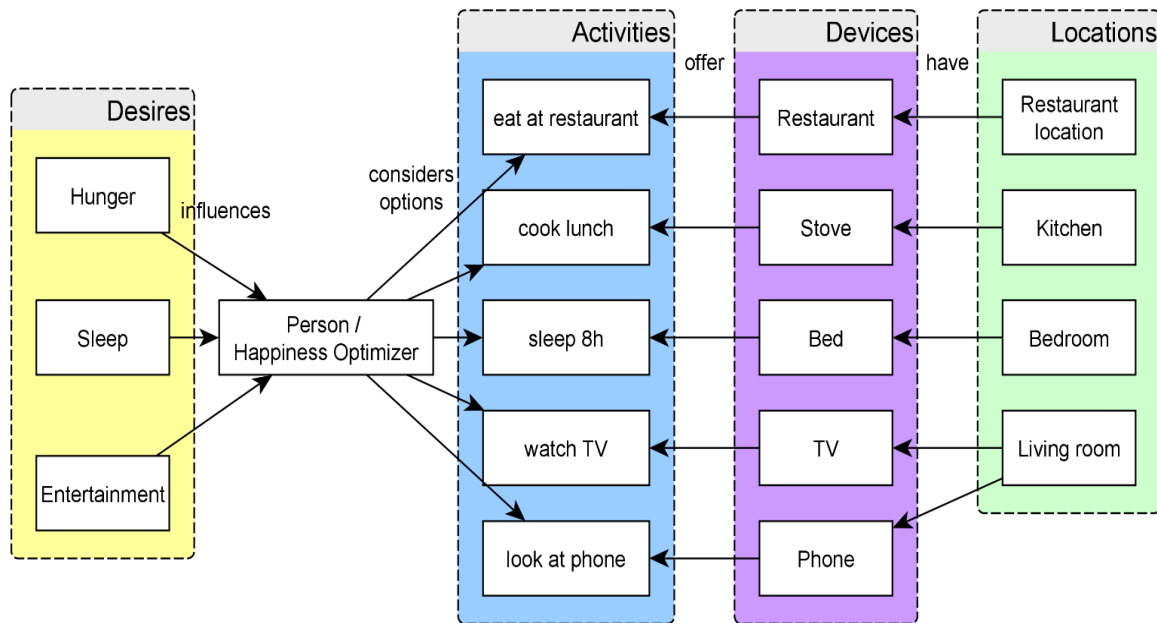
[Laura Alessandretti](#), [Piotr Sapiezynski](#), [Vedran Sekara](#), [Sune Lehmann](#)  & [Andrea Baronchelli](#) 

[Nature Human Behaviour](#) **2**, 485–491 (2018) | [Cite this article](#)

 **Utility maximisation
is not helpful here**

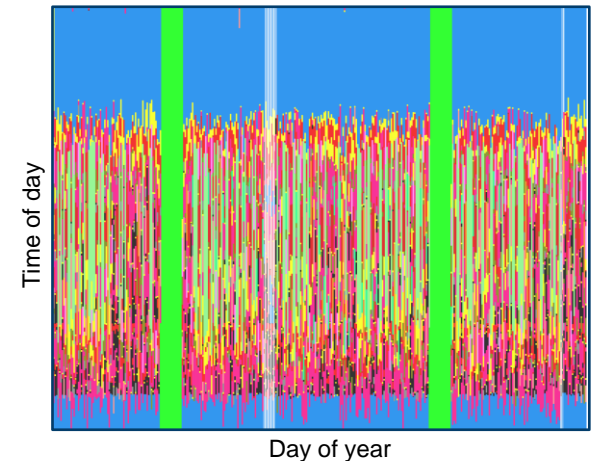
Desire-Based Activity Simulation: LoadProfileGenerator

Simulation tool for residential energy demand
Consecutive simulation of one year (1 min. resolution)
Desire-driven: individual desires fulfilled through activities
Household dynamics and other restrictions for realism
Computation time: 1.0s per agent per day (1 core)

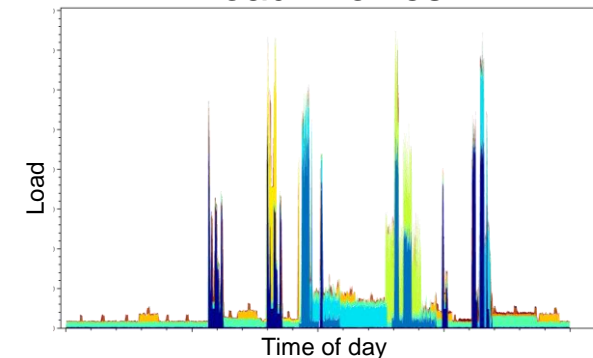


Results

Activity Profile



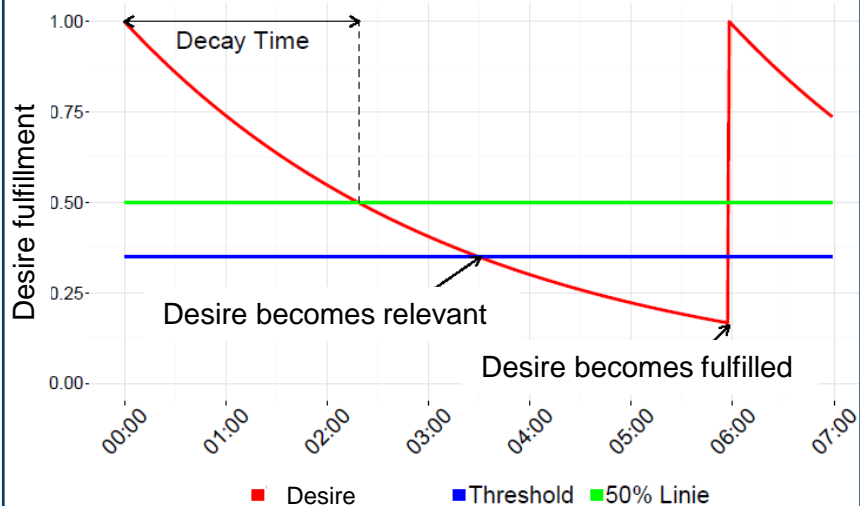
Load Profiles



Pflugrad, Noah, Peter Stenzel, Leander Kotzur, und Detlef Stolten. „LoadProfileGenerator: An Agent-Based Behavior Simulation for Generating Residential Load Profiles“. *Journal of Open-Source Software* 7, Nr. 71 (25. March 2022): 3574. <https://doi.org/10.21105/joss.03574>.

LoadProfileGenerator Method

Psychological approach:



Desire B_t

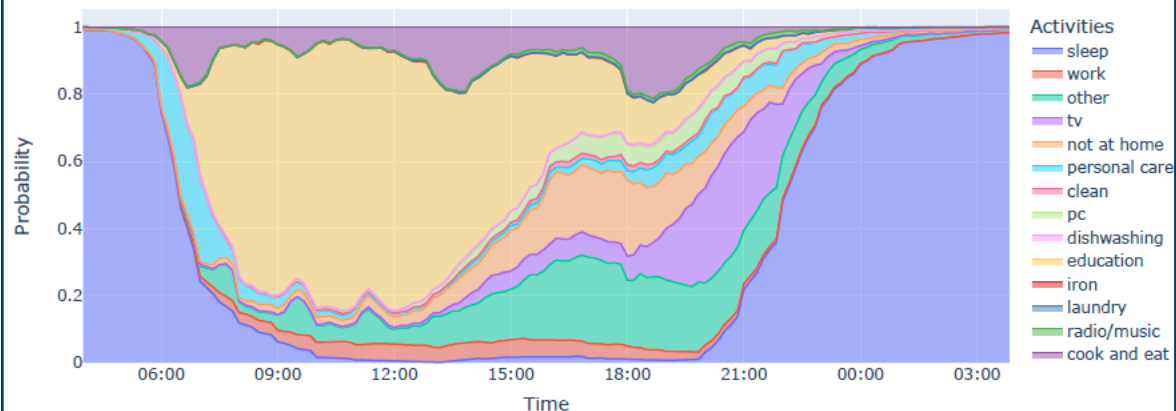
$$B_{t+1} = e^{\left(\frac{\ln 0.5}{T_{decay}}\right)} \cdot B_t$$

Two desire sets: healthy; ill

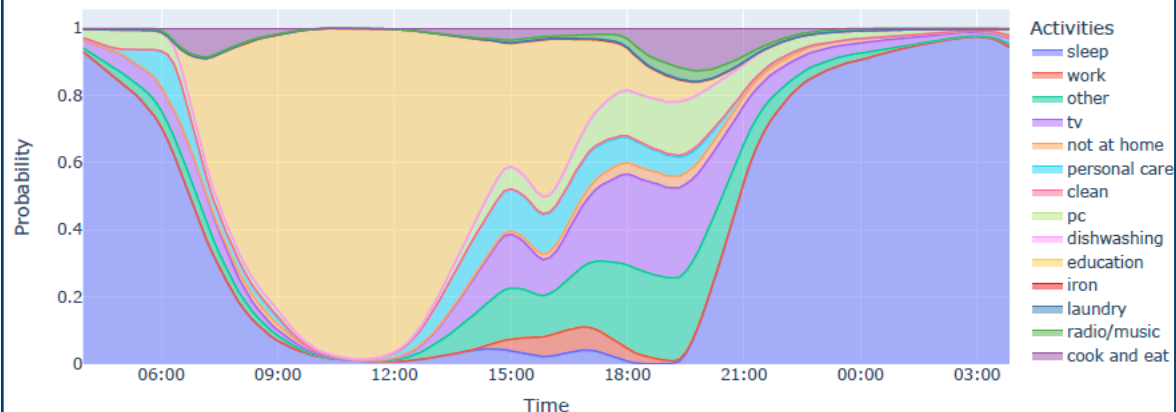
Pflugradt, N. (2016). Modellierung von Wasser und Energieverbräuchen in Haushalten [PhD thesis]. Chemnitz. <http://nbn-resolving.de/urn:nbn:de:bsz:ch1-qucosa-209036>

Member of the Helmholtz Association

Validation with time use data



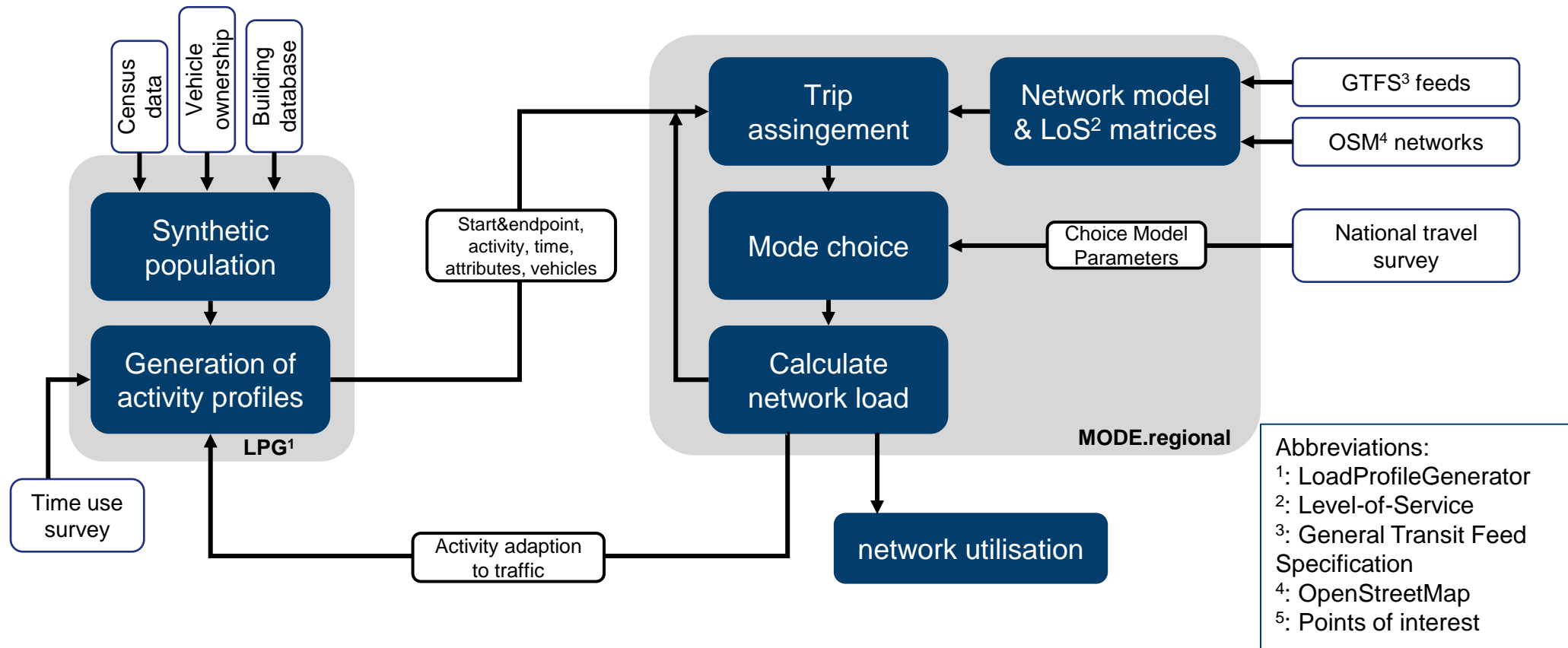
(a) Validation dataset



(b) LoadProfileGenerator

Neuroth, D. et al. (*under review*). ETHOS.ActivityAssure – an open source validation framework for synthetic European activity profiles.

Coupling Desire-Based Activity Simulation with Aggregated Assignment



Computation time estimation for 1 year, 1000 agents in 500 households (Port Louis, Mauritius with 900 POIs⁵)

$$3 \text{ min} * 1000 + [(40s + 2s) * n_{iter.assign} + 180s + 200s + 400s + 20s] * n_{interval}$$

Activity profiles car pathfinding + mode choice cycle pathf. + walk pathf. + PT pathf. + assignment 3*4 or 3*13

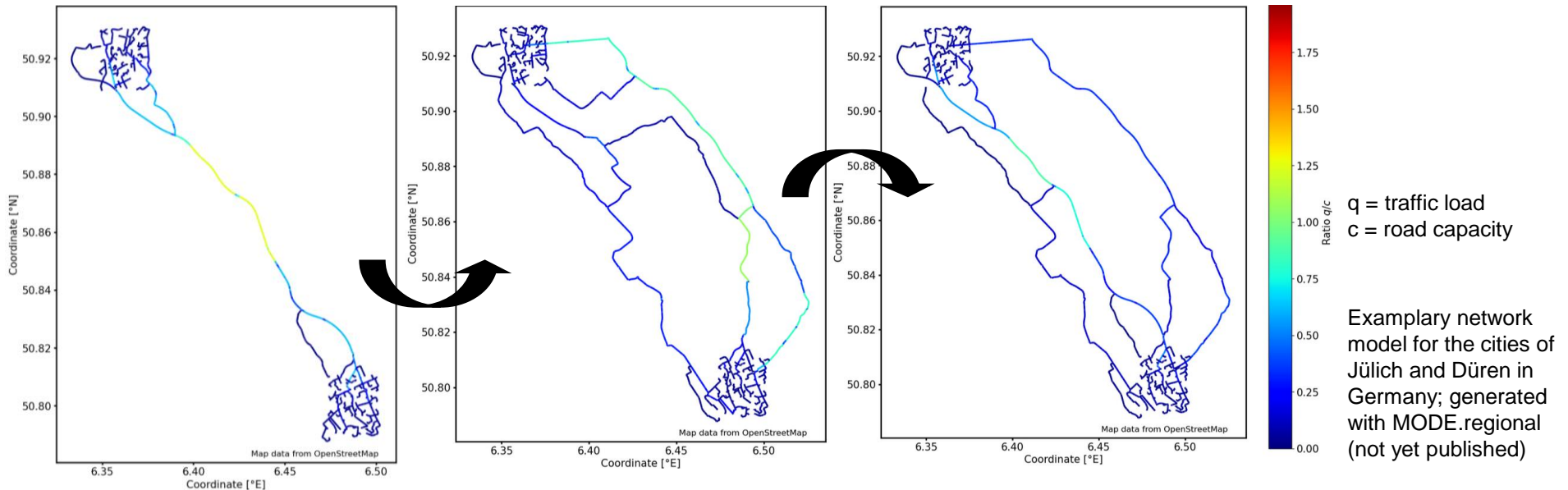
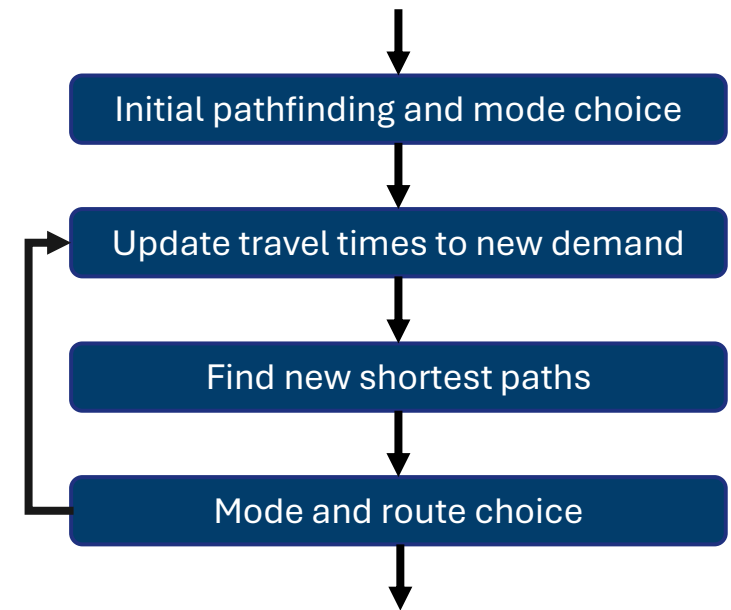
$$= 50h$$

$$= 0.25h * n_{interval} = [3h \dots 10h]$$

* n_{iter}

MODE.regional Aggregated Assignment

- Mode choice: utility maximization
- Mode choice ~ route choice (to be estimated)
- Different models for agents
- Aggregated assignment for adjustable time intervals
- Iterate mode choice after 2-3 assignment iterations



Discussion

Downsides

- No traffic flow simulation
- Must convert all insights from research based on random utility maximisation

Advantages

- Temporal resolution in assignment adjustable to computation time needs
- Agent interactions in household
- Implicit habits simulation
- Integrated energy and transport modelling
- Method suits 21st century economic thinking better