

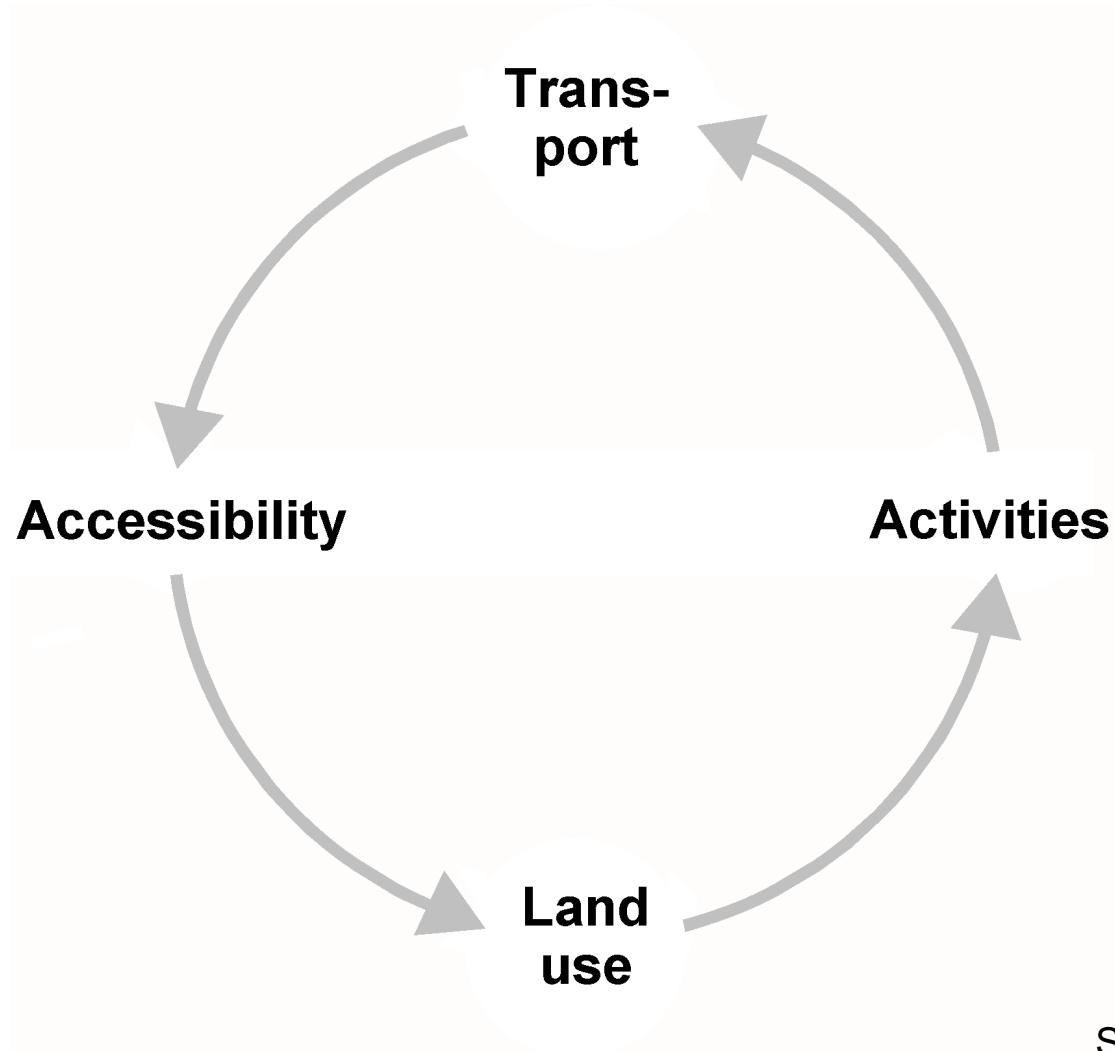
# Microscopic integration of land use & transport: Improving sensitivities in a future of constraints

**Rolf Moeckel, Technical University of Munich**

*Symposium for the Integration of Land-Use and Transport Models*

*2 - 4 November 2016 • Raitenhaslach, Germany*

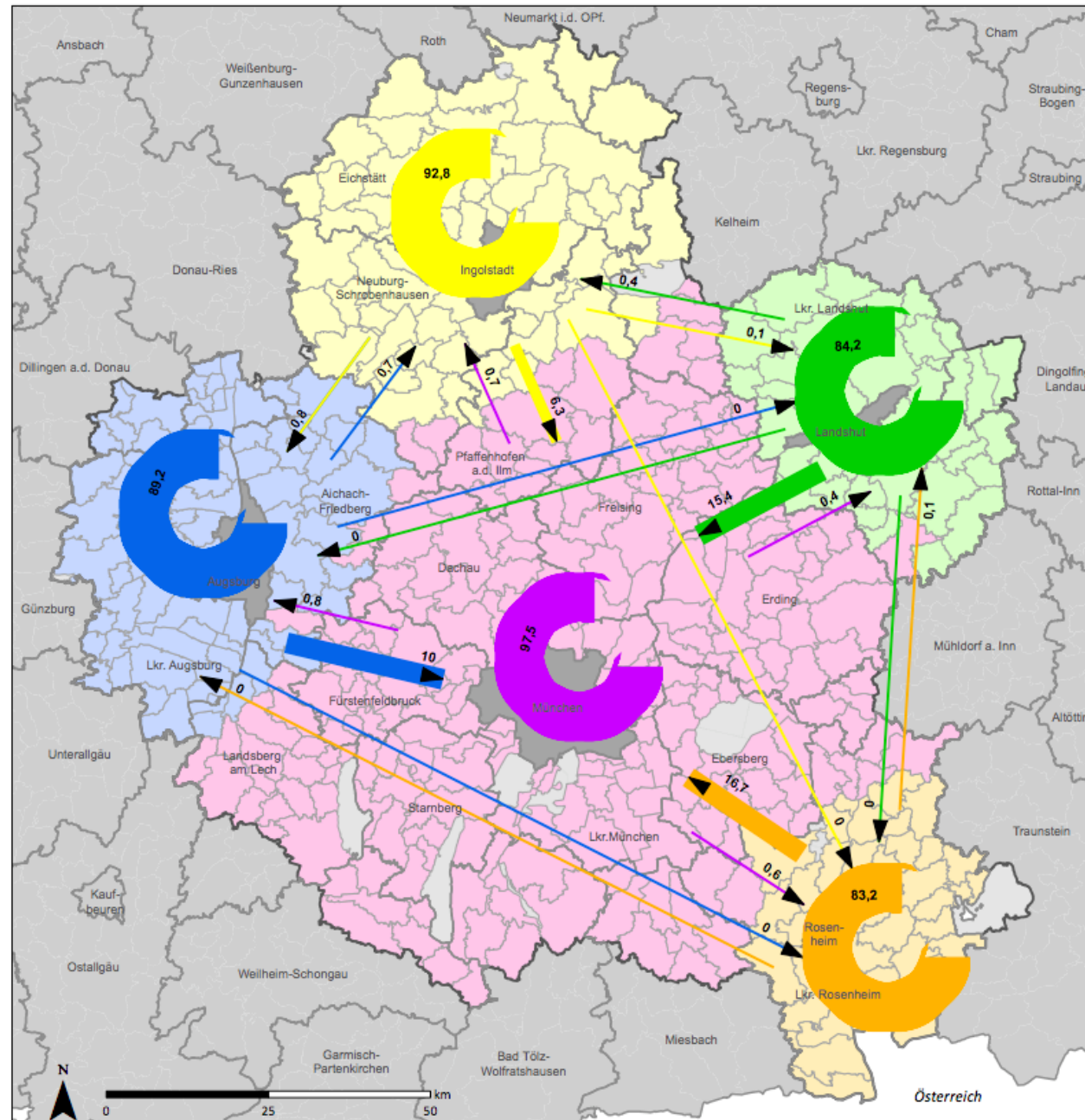
## Land Use/Transport Feedback Cycle



Source: Wegener & Fürst 1999

# Model Design

# Commute Patterns in Munich Metropolitan Area



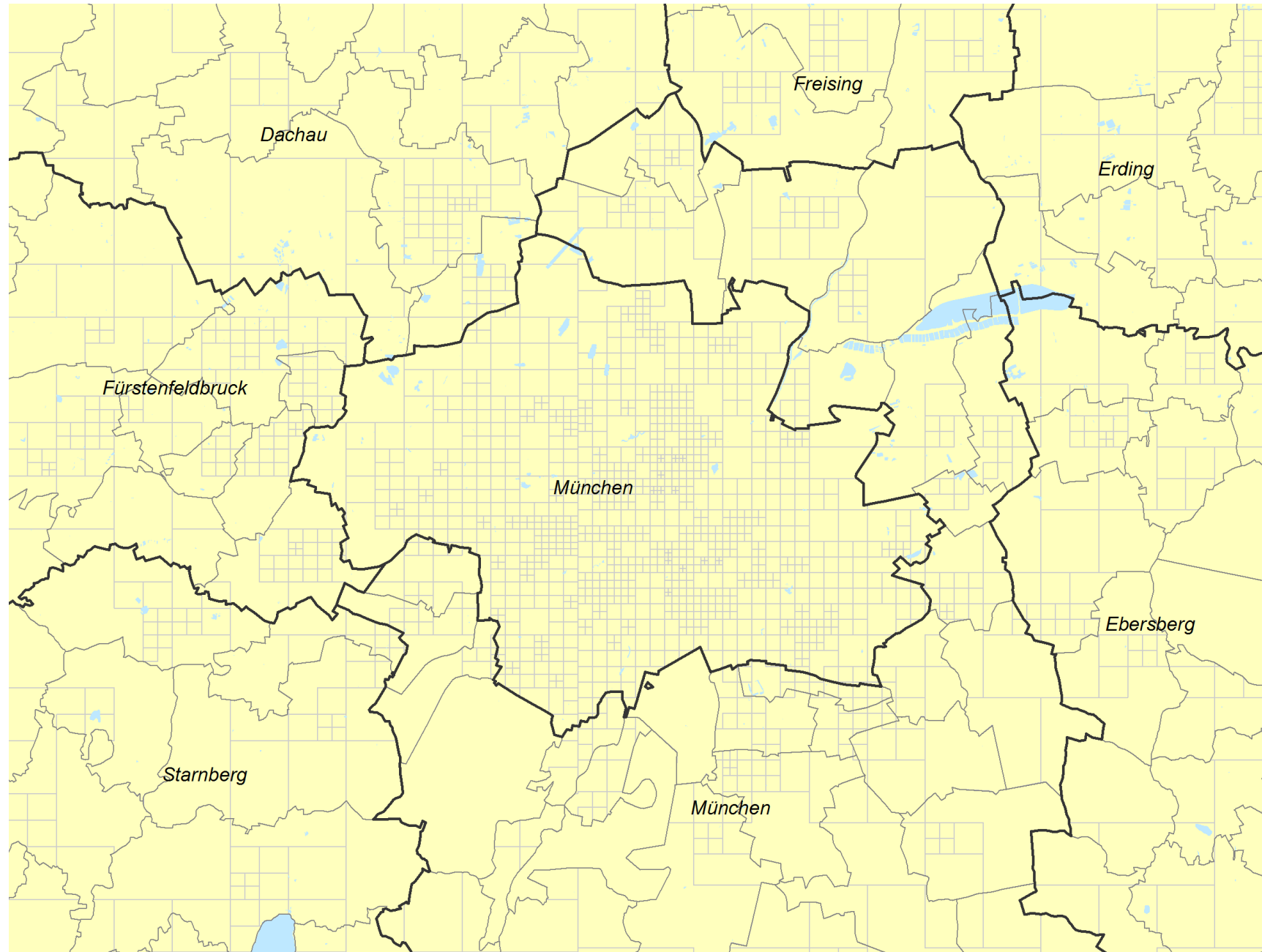
Five central cities (Augsburg, Ingolstadt, Landshut, Munich and Rosenheim) and their suburbs

Population: 4.5M people living in 2.1M households

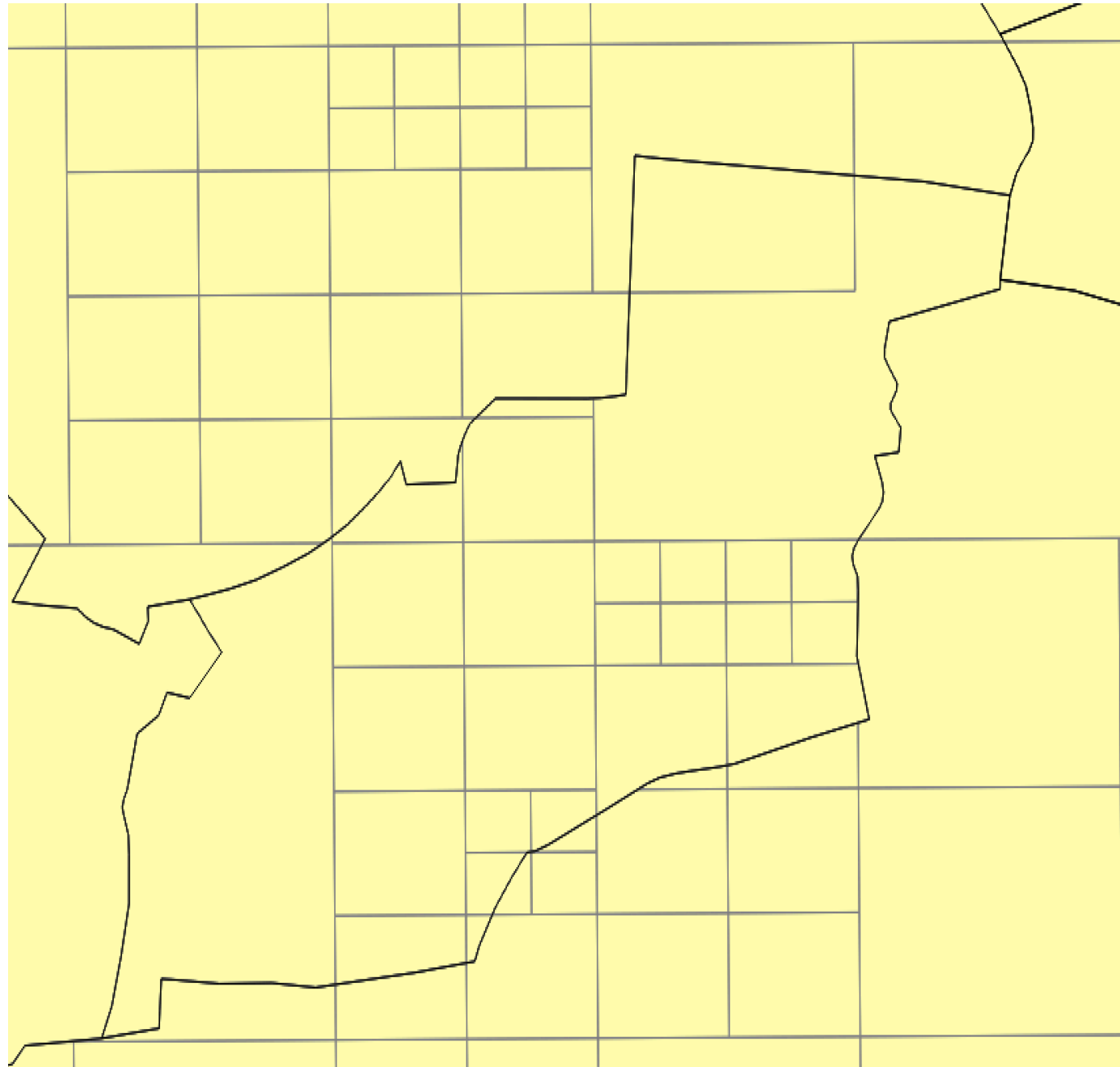
# Raster cells for Munich Metropolitan Area



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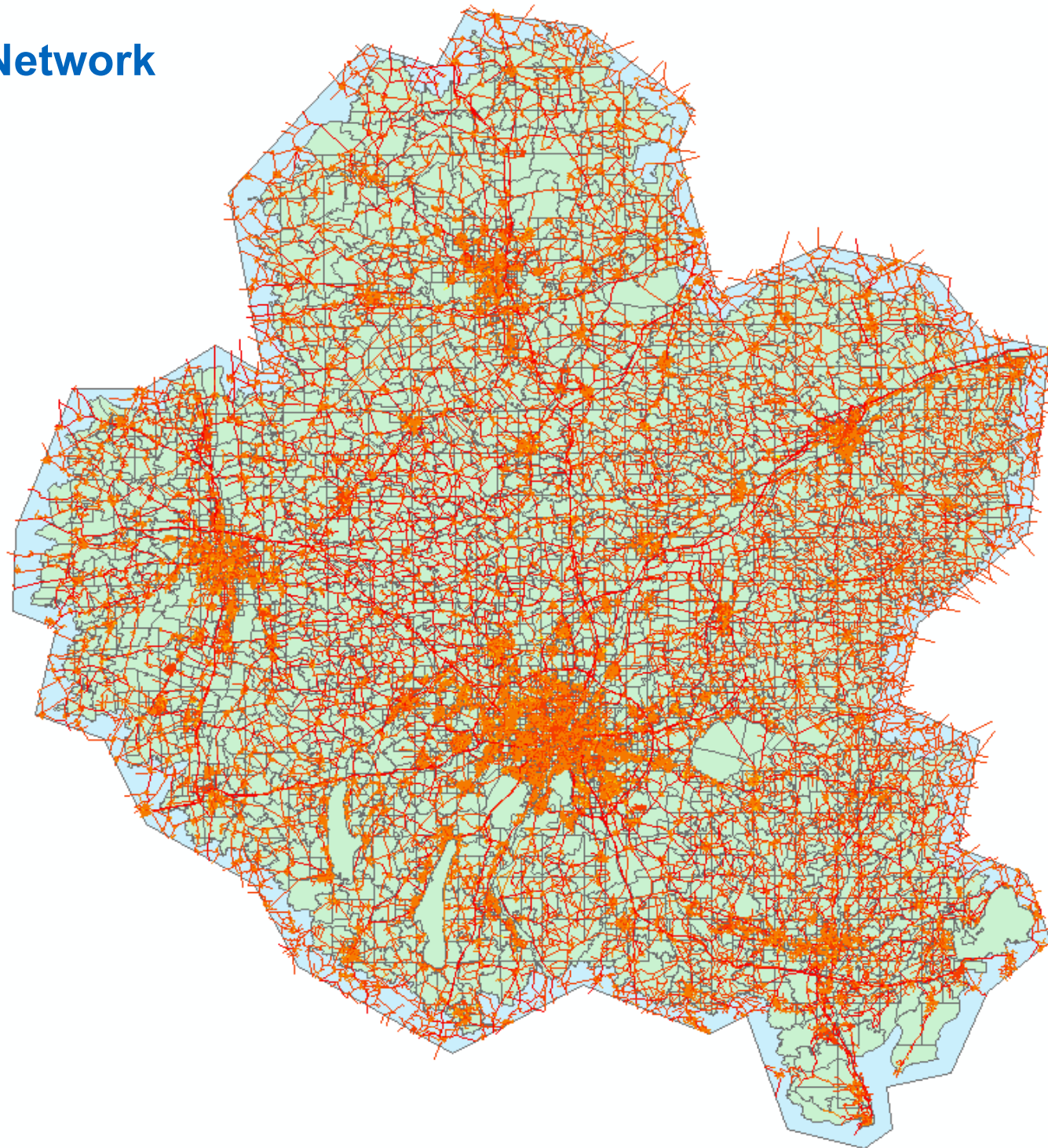


## Merge Slivers





# Highway Network





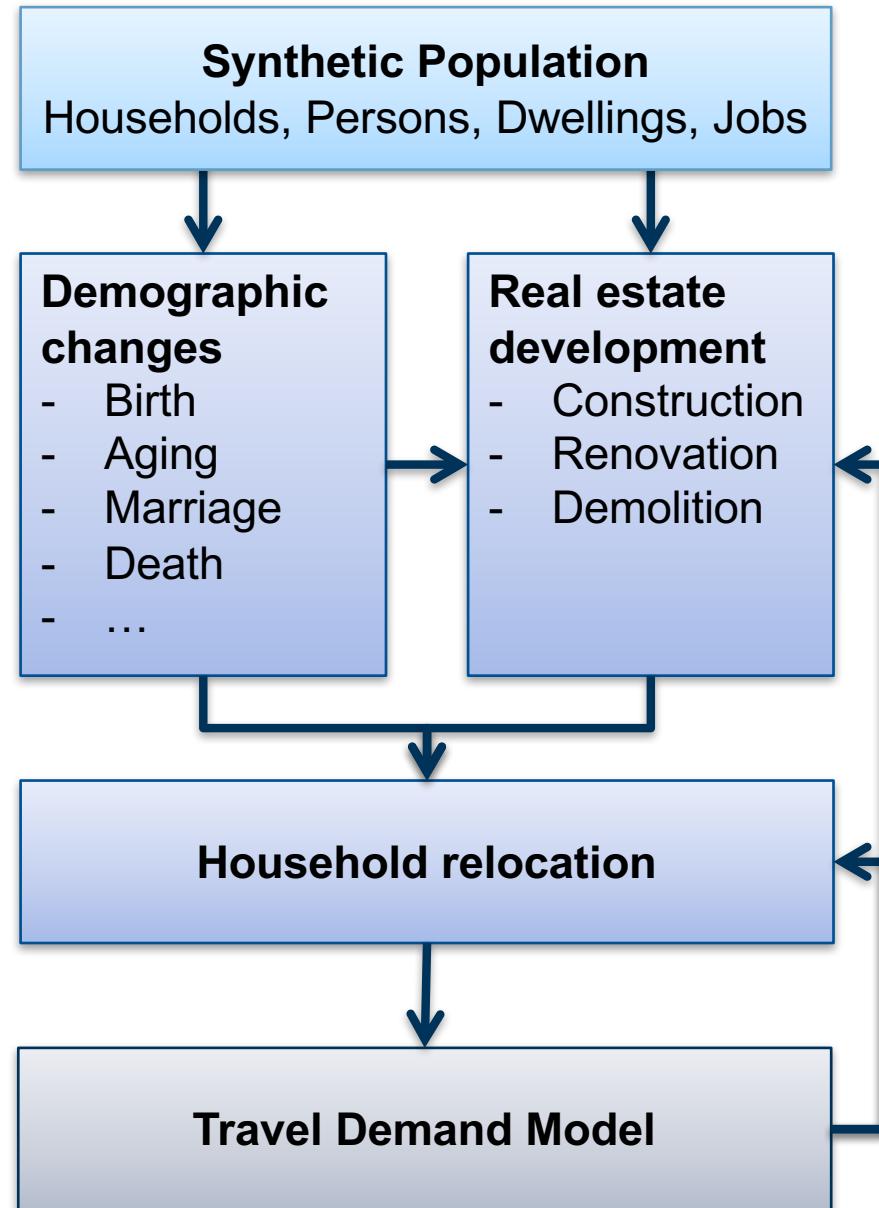
# SILO Model Concept

Microscopic land-use model,  
fully integrated with travel  
demand model

Three implementations

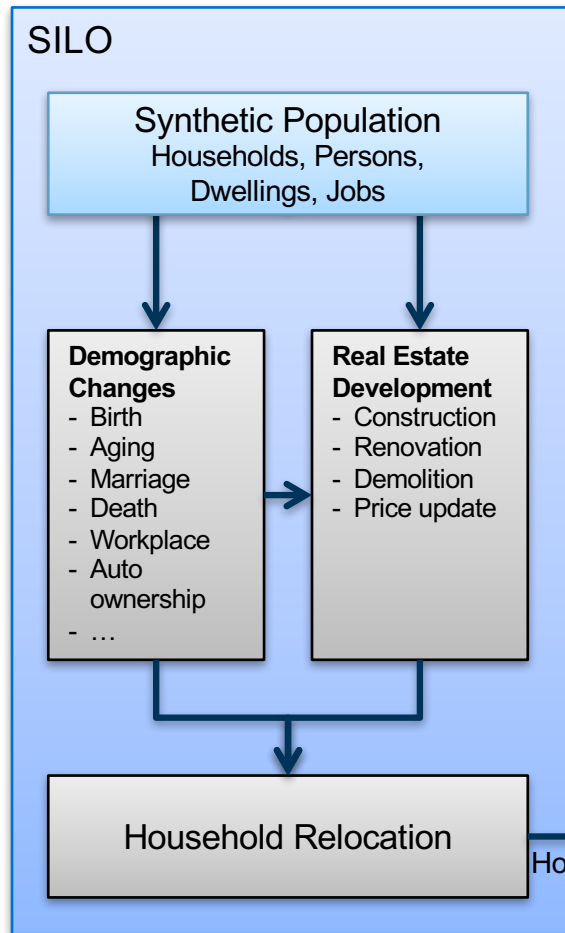
- Minneapolis/St. Paul
- Maryland
- Munich, Germany

Open source: [www.silo.zone](http://www.silo.zone)

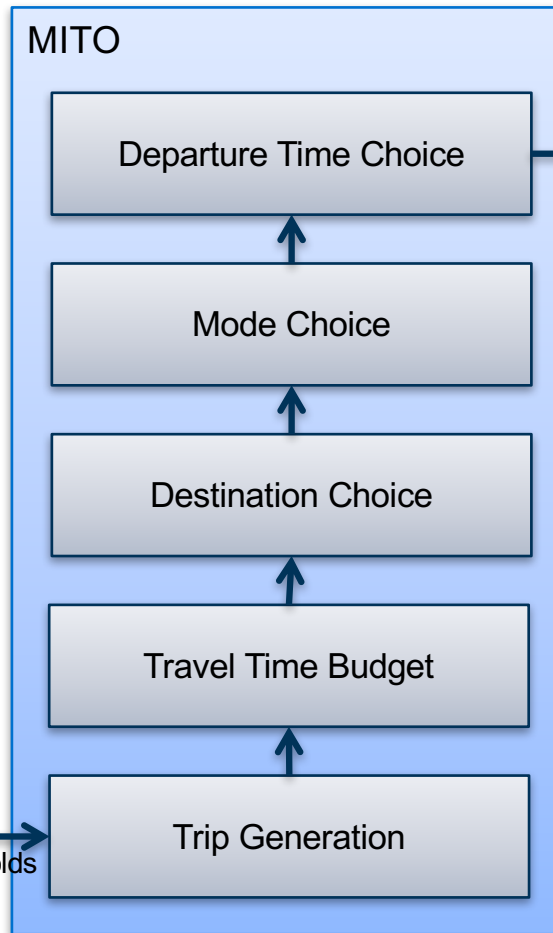


# Integrated Land Use/Transport Model

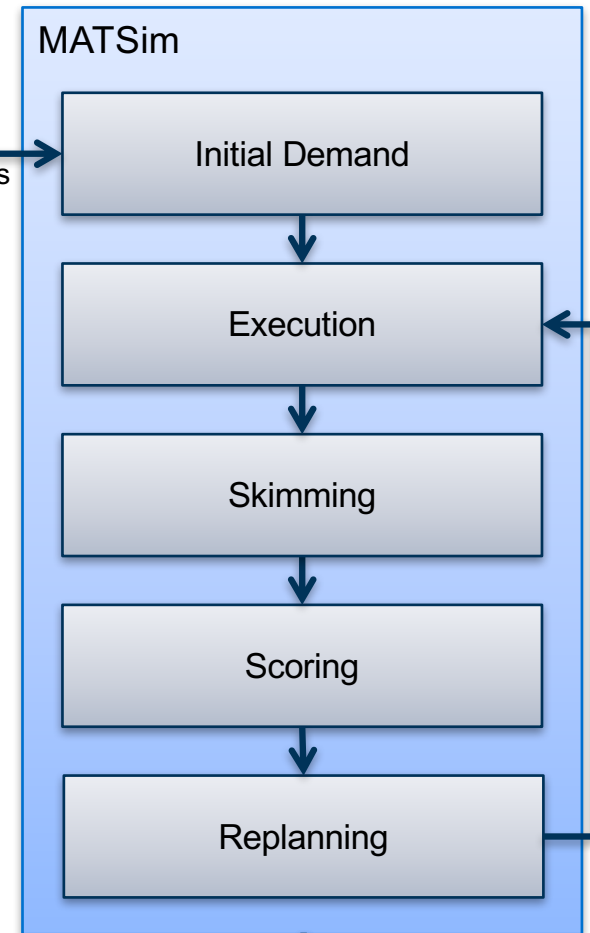
## Land Use



## Travel Demand



## Assignment



Zone-to-zone travel times and reliability

# Events simulated in SILO

<i>spatial</i>	<i>Population</i>	<i>Dwellings</i>
	<ul style="list-style-type: none"><li>• move</li><li>• immigrate/outmigrate</li></ul>	<ul style="list-style-type: none"><li>• build new dwellings</li></ul>
<i>aspatial</i>	<ul style="list-style-type: none"><li>• aging</li><li>• child is born</li><li>• leave parental household</li><li>• get married/cohabitate</li><li>• get divorced/separate</li><li>• death</li><li>• change job</li><li>• change of income</li><li>• buy or sell cars</li></ul>	<ul style="list-style-type: none"><li>• renovate dwelling</li><li>• dwellings deteriorate</li><li>• demolish dwelling</li><li>• price adjustment</li></ul>

# Modeling Constraints

Location choice is based on utilities

$$u_i = \alpha \cdot size_i + \beta \cdot price_i + \gamma \cdot location_i + \dots$$

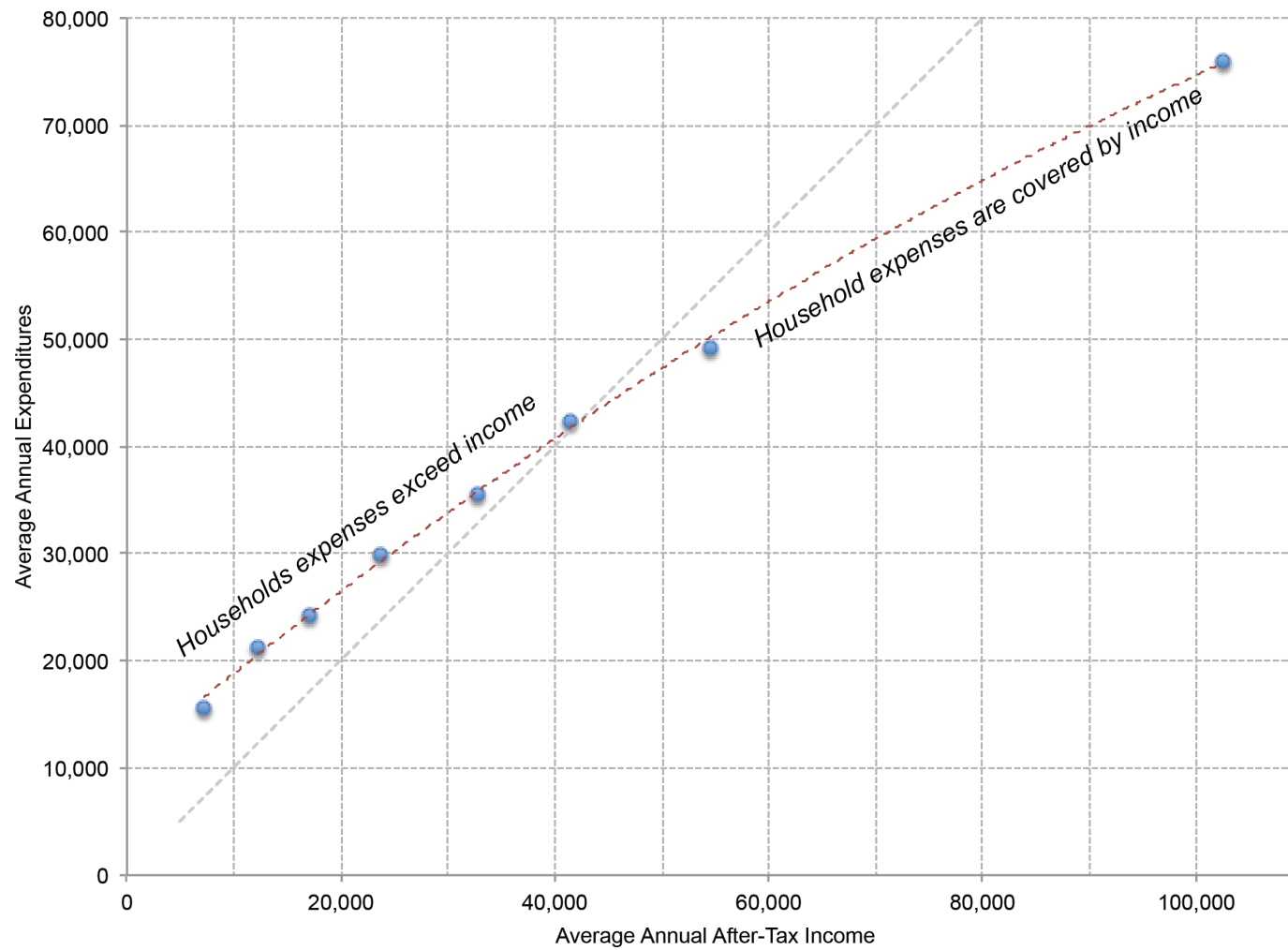
In reality, most choices are made under constraints

- Price of dwelling
- Travel costs
- Parking availability

Modeling human behavior is less about maximizing utilities, but satisfying needs.

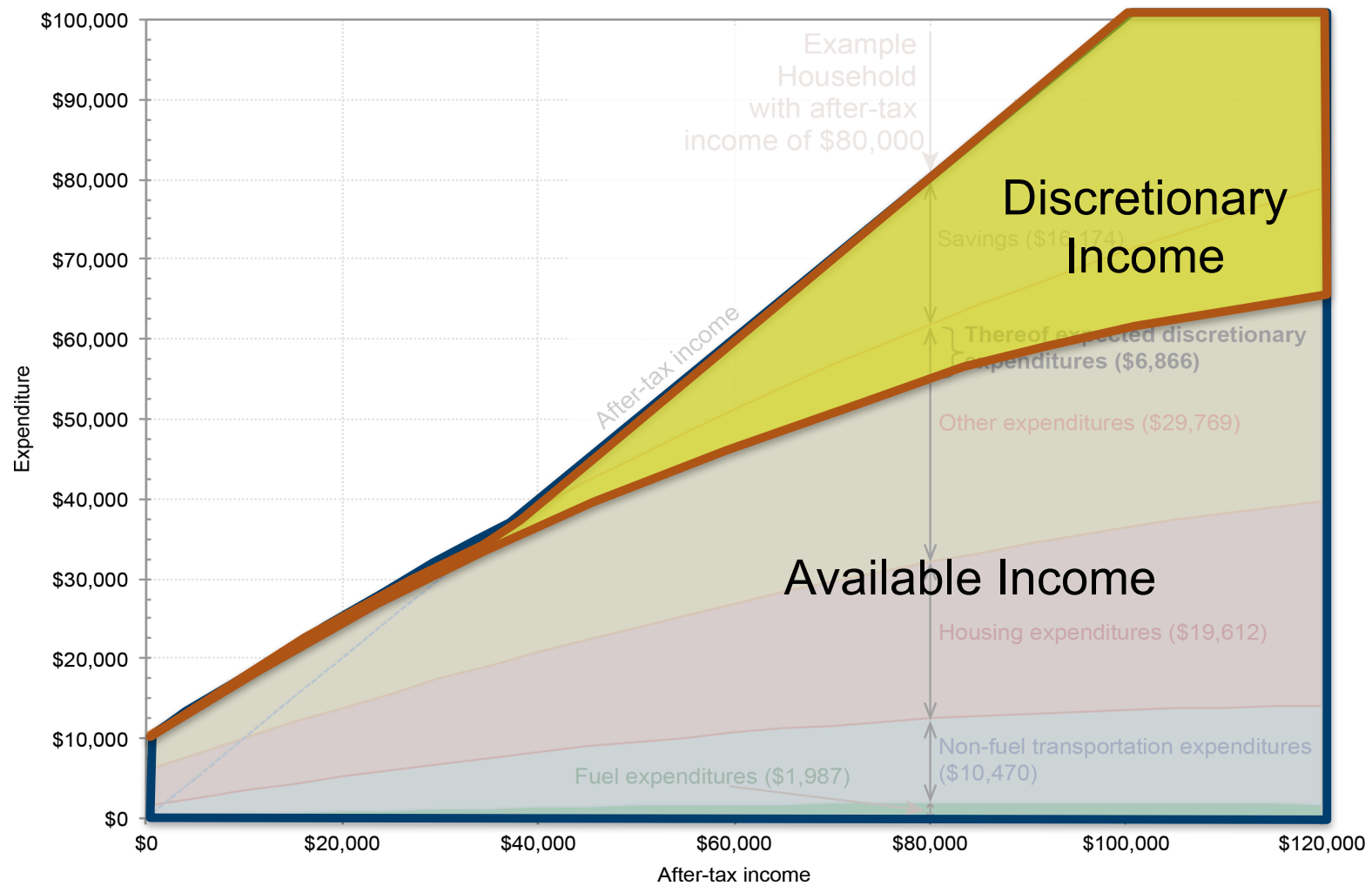


# Household expenditures

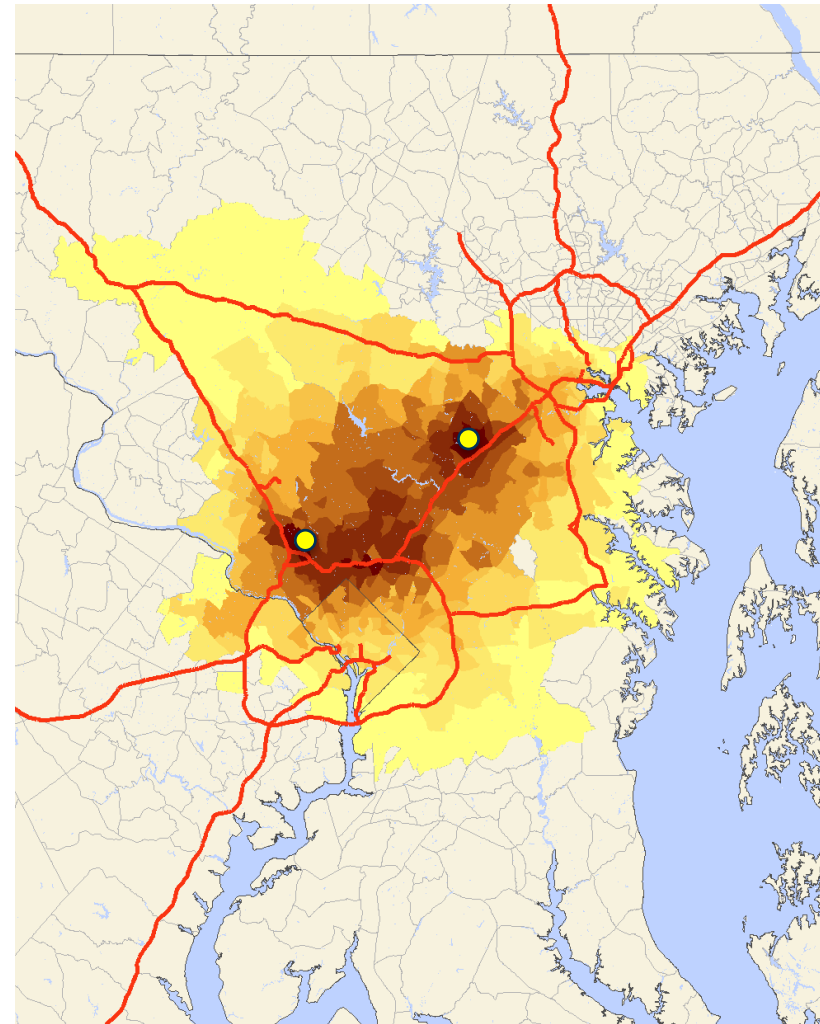
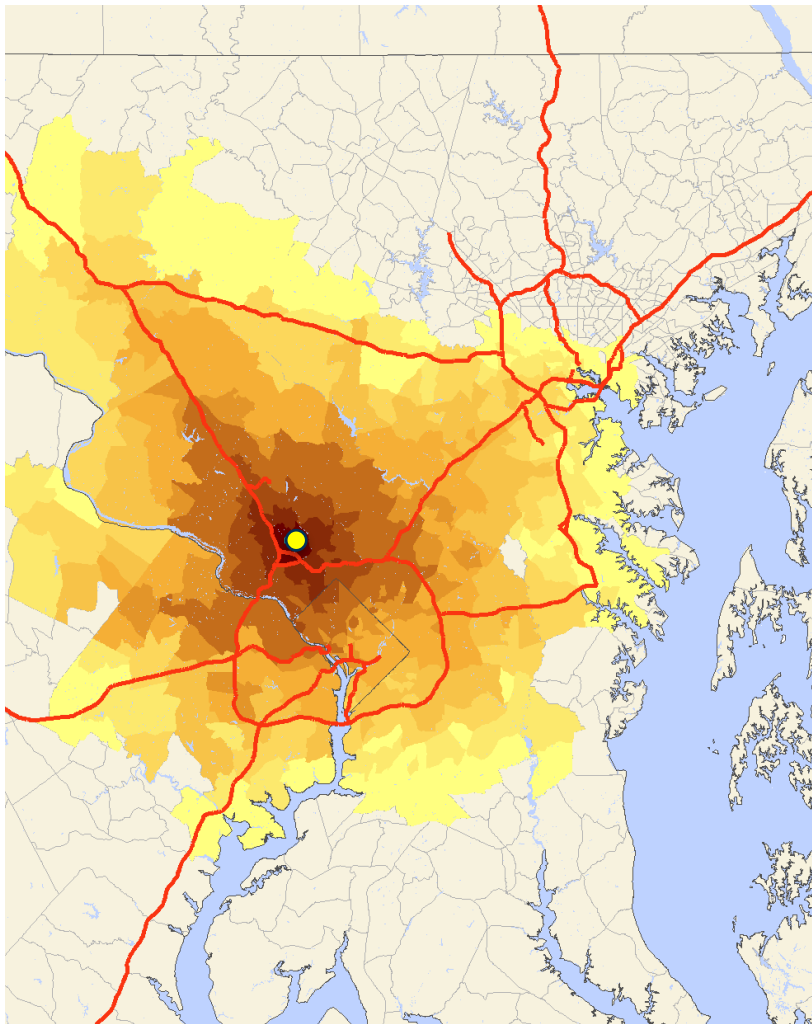


Source: BLS Consumer Expenditure Survey

# Household expenditures



Source: Own estimation based on U.S. BLS Consumer Expenditure Survey

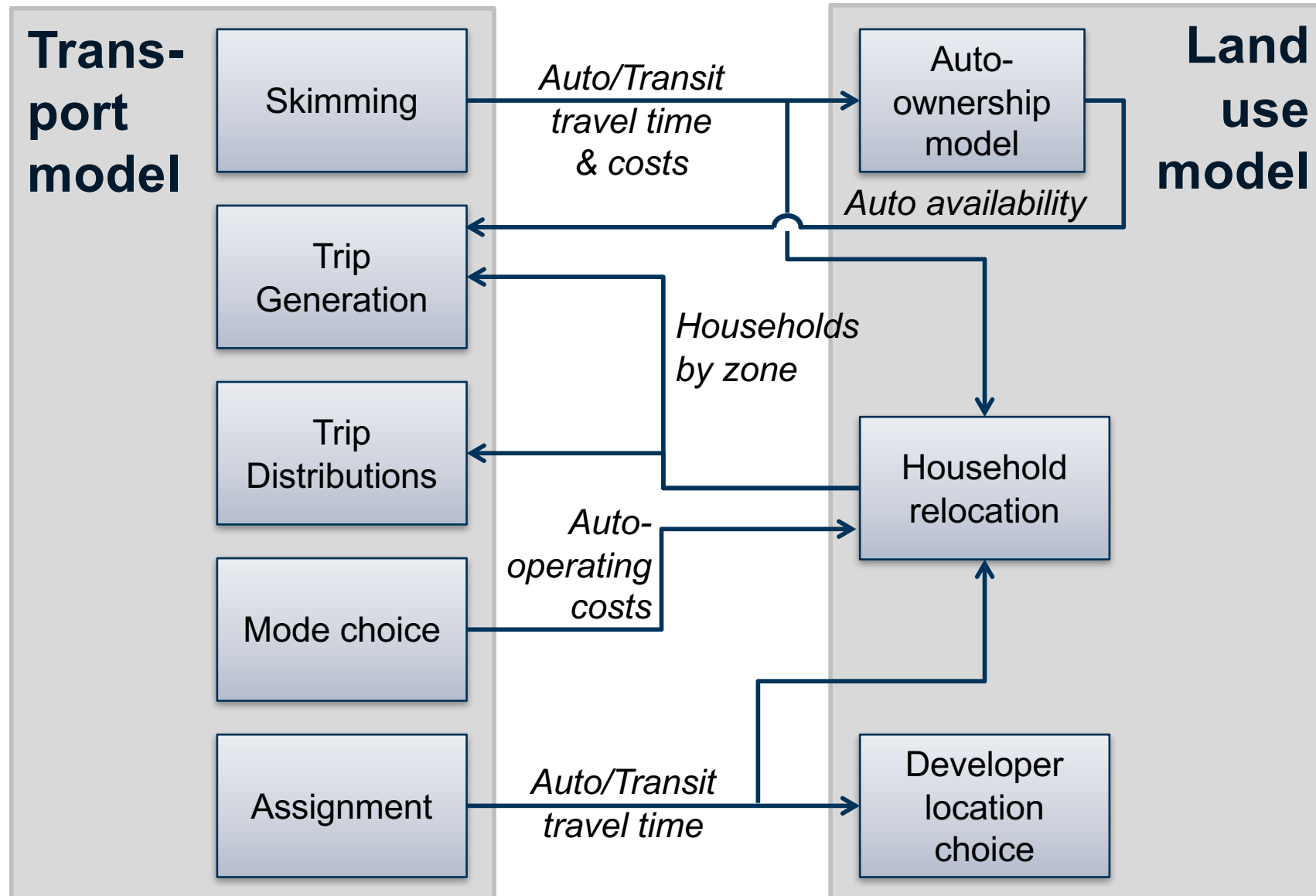


Replaceable location factors are added:

$$u_{replaceable} = \alpha \cdot util_{size} + \beta \cdot util_{quality} + \gamma \cdot util_{accessibility} + \dots$$

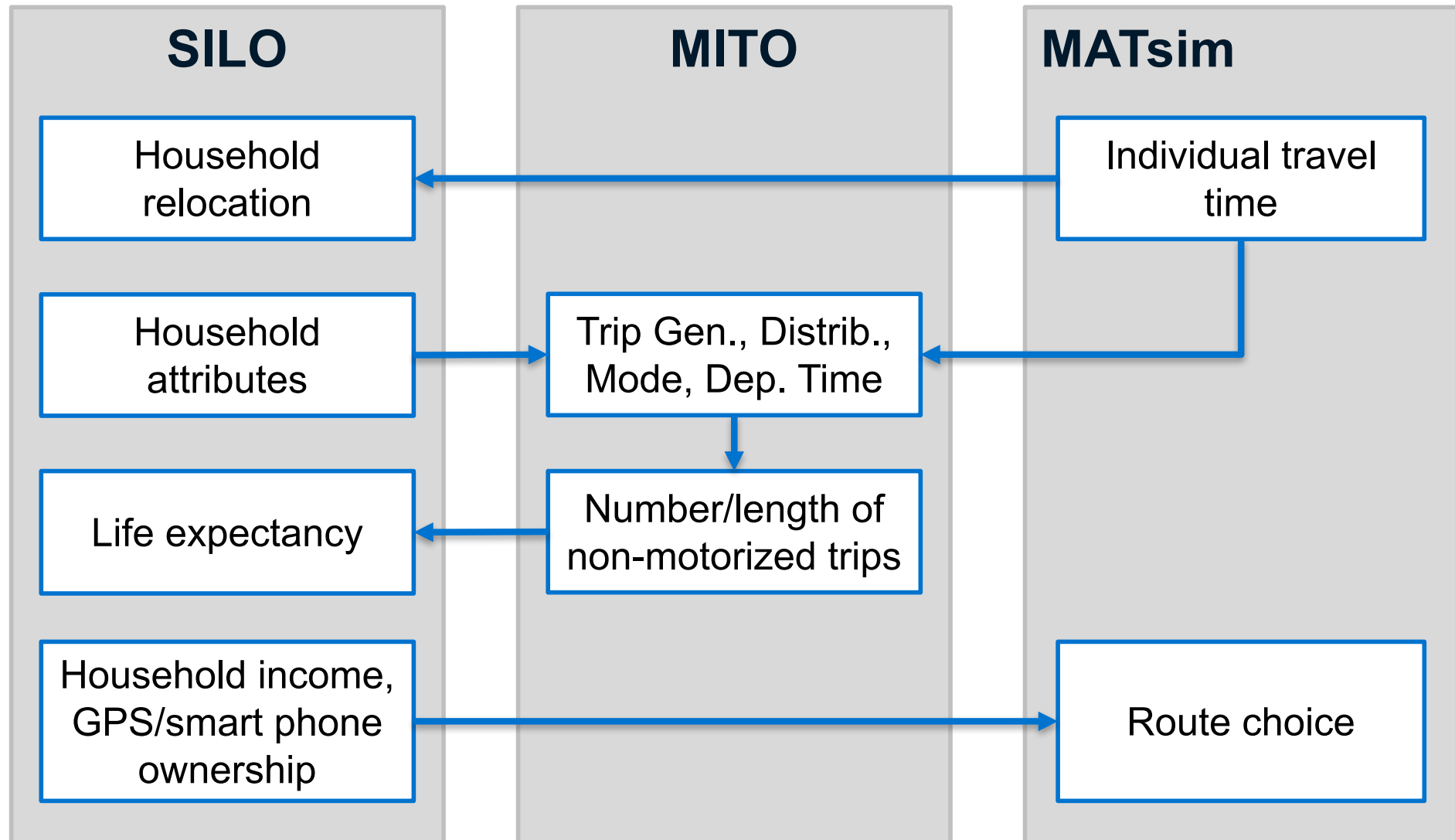
Essential location factors are multiplied:

$$u = u_{replaceable}^{\alpha} \cdot u_{rent}^{\beta} \cdot u_{travelCosts}^{\gamma} \cdot u_{commuteTime}^{\delta} \cdot \dots$$





# Proposed Microscopic Model Integration



## Final Remarks

Most important **benefit of microsimulation** is the flexibility to freely **add attributes** to households, persons, dwellings, vehicles or jobs.

Microscopic model integration will help to represent **individual constraints** in terms of time and money.