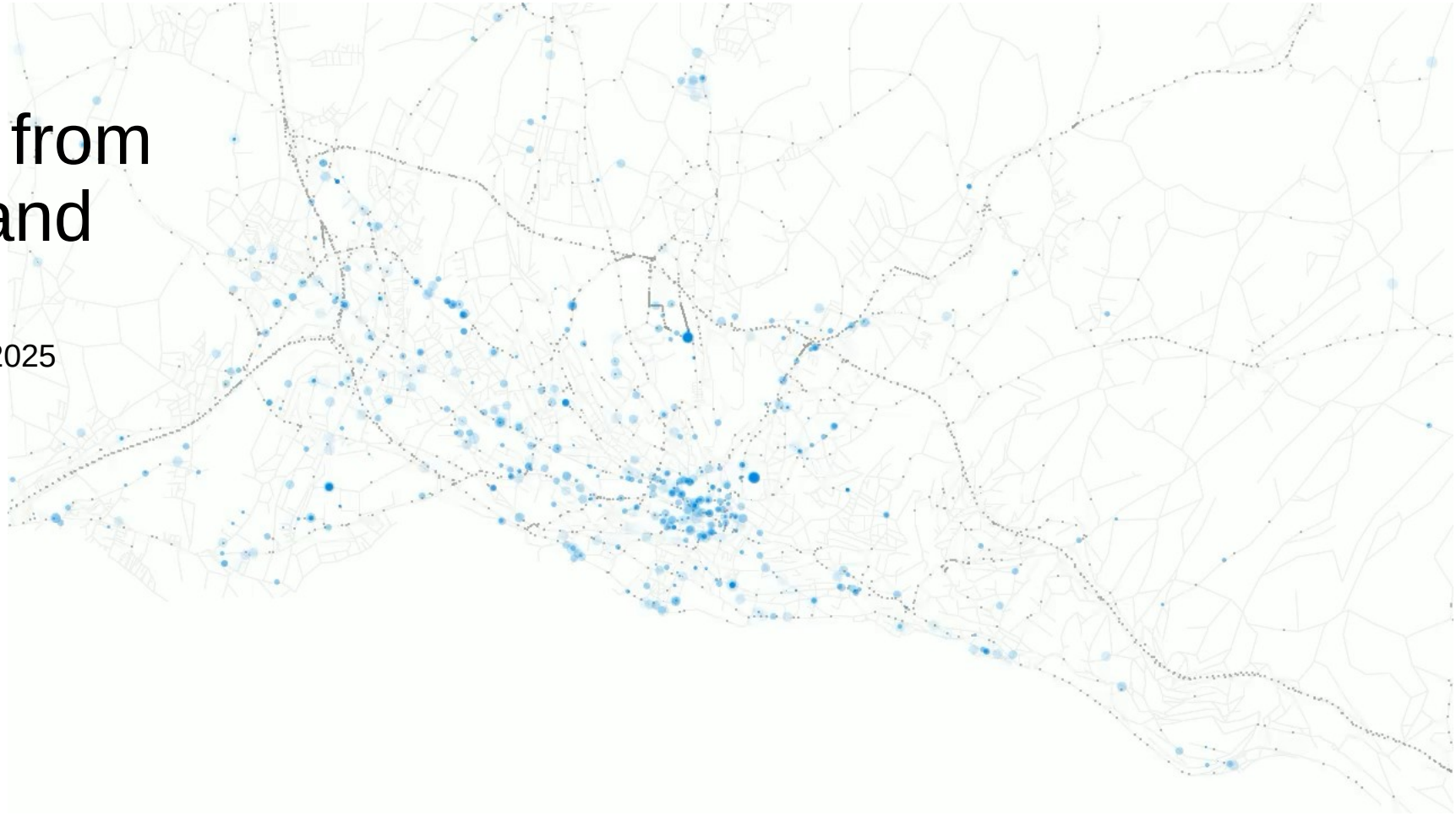
ETH zürich

Updates from Switzerland

Milos Balac
eqasim Workshop 2025



Background

- We have been developing eqasim-switzerland since 2018 (?) which was based on a much older pipeline built in R
- The pipeline did not see many updates or improvements in terms of methods or data until the end of 2024, while it was under the care of the Institute for Transport Planning at ETH Zurich
- It is maintained since then at the Competence Center for Mobility (CSFM) at ETH Zurich

Background

- We partnered with tpg, tl, the City of Lausanne to bring eqasim-switzerland into practice
- Collaborative Mobility Digital Platform (CMDP):
  - Funded by Innosuisse
  - Supported by Canton Geneva, Canton Vaud, Citec, Transitec, SDSC, Transcality, Mobil.Home, Modus
  - 04.02025 - 03.2027
- Developed model:
  - Needs to be automated from start to end
  - Needs to be accessible
  - Needs to be robust
  - Needs to allow experimentation
  - Needs to be trustworthy

CMDP – Main Tools

eqasim – an activity-based model

MATSim – an agent-based simulation

eqasim-switzerland new features

- Statistical matching
- Workplace assignment
- Secondary Location assignment
- Mode-choice within eqasim

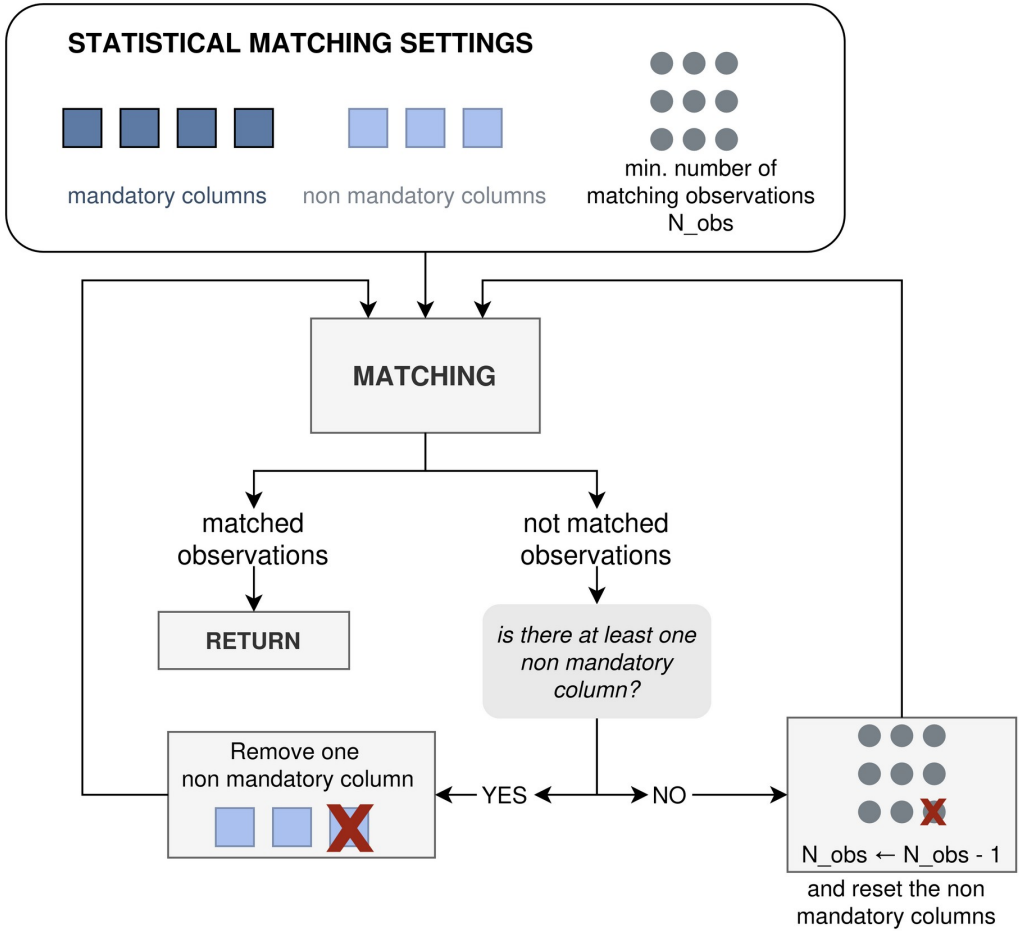
Matching

Statistical matching: find similar observations between census and travel survey to assign a trip schedule to each synthetic agent.

Challenge: some matching columns are more important than the others. For them, we prefer decreasing the number of required matching observations than risking not matching on these attributes.

Proposed solution: a recursive version of the statistical matching algorithm. Termination step (N_obs = 1): all columns are considered non-mandatory.

Contact: Aurore Sallard(aurore.sallard@csfm.ethz.ch)



Workplace assignment

The algorithm assigns a workplace to every agent in three steps, ensuring macro-level consistency with travel survey data.

Zone Sampling

- For each home zone, the algorithm determines the set of destination zones where its residents will work.
- It calculates the probability of traveling to every other zone based on the residents' commute modes and the OD matrices.
- It uses multinomial sampling to generate a fixed count of destination zones (e.g., "5 people go to Zone A, 3 to Zone B").

Candidate Identification

- For each person (agent), the algorithm identifies potential workplaces.
- It looks at the "bag" of sampled destination zones available for the person's home zone.
- It retrieves all companies located within those specific destination zones. These companies become the candidate set for this person.

Workplace assignment

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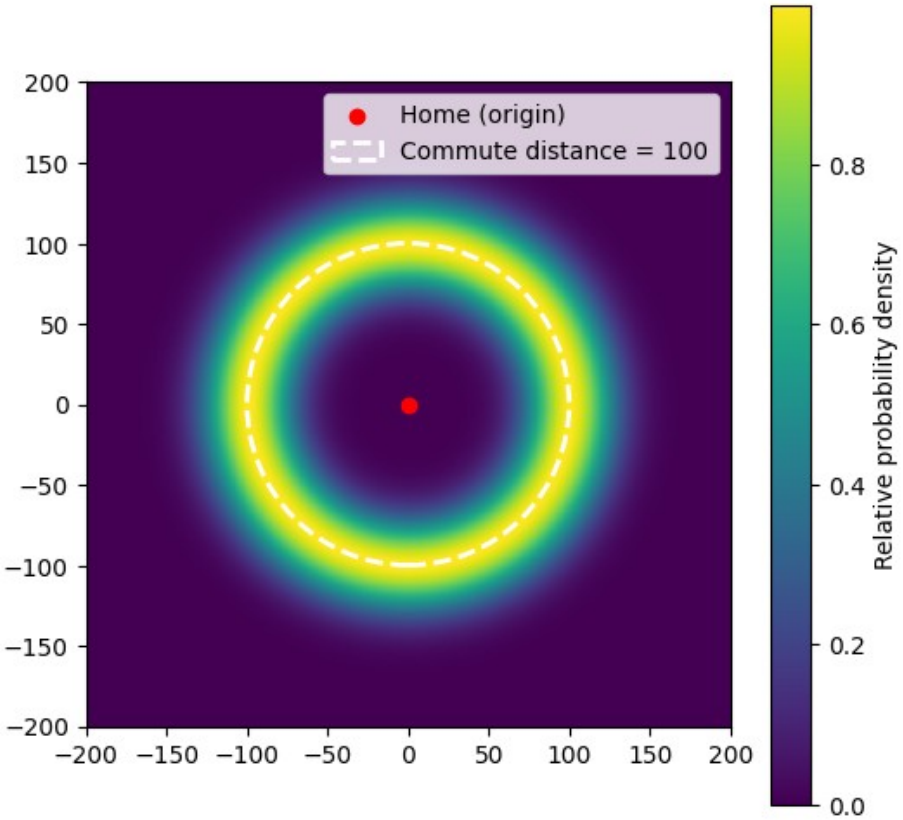
Building Probability and Selection

- The algorithm selects one specific company from the candidates.
- Scoring: It assigns a probability weight to each candidate company based on two factors:
  - Size: The number of employees (larger companies are more likely).
  - Distance Match: How well the distance to this company matches the person's target commute distance (derived from the travel survey).

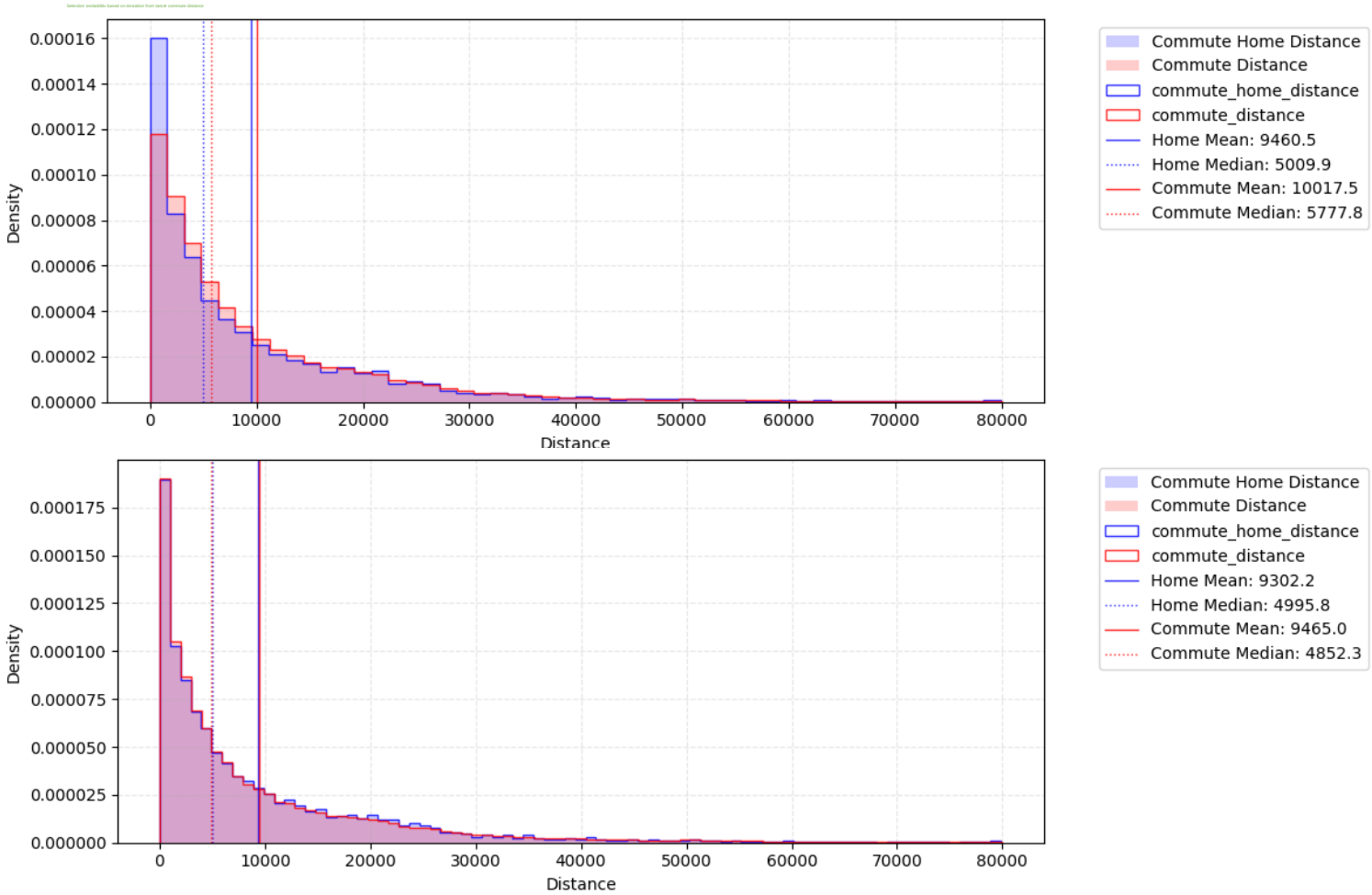
Workplace assignment

Selection probability based on deviation from target commute distance



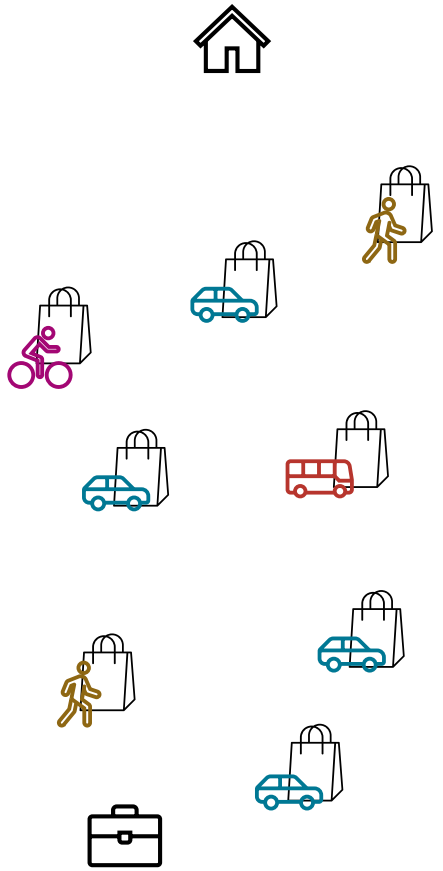
- Selection: It samples one company based on these calculated probabilities.
- Update (Without Replacement): After selection, it decrements the count for that destination zone in the "bag" and reduces the selected company's weight (employee count) so it is less likely to be chosen by future agents.
- Contact: Abdelkader Dib (abdelkader.dib@csfm.ethz.ch)

eqasim new features – Workplace assignment



Eqasim new features – Secondary location assignment

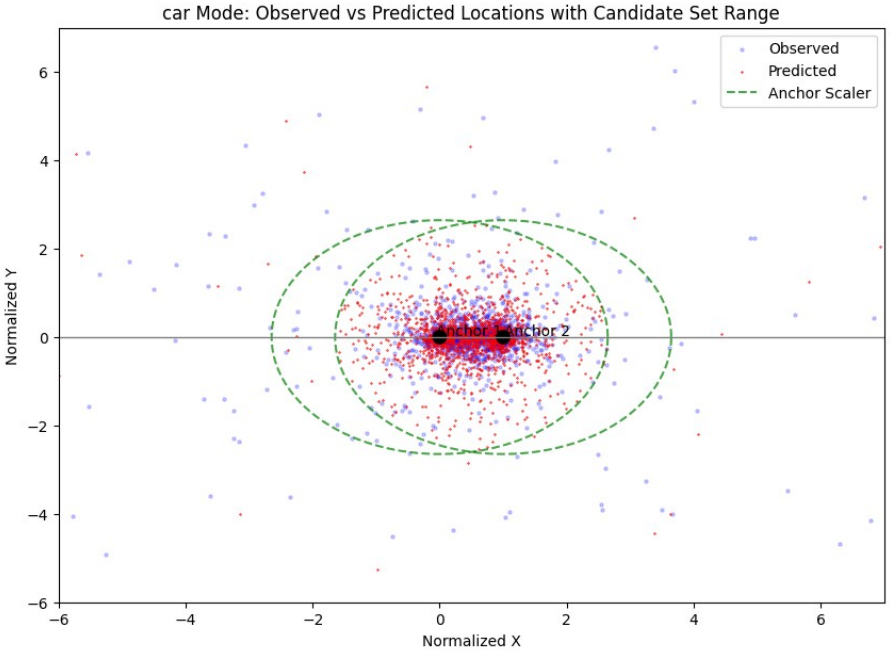
- Given two primary locations and purpose. *Which secondary location will an agent choose?*
- For each agent, we will **jointly** select the **mode and location:**
  - Filter candidate locations using NOGA (i.e., purpose) category based on the purpose of the secondary location *(i.e., grocery vs active leisure)*
  - For each *mode*, we sample K_m secondary locations weighted by attractiveness.
  - K_m calibrated so that chosen modes match real mode share (dependent on car/bike ownership)



Given the start and end primary locations, sample mode/secondary location pairs jointly.

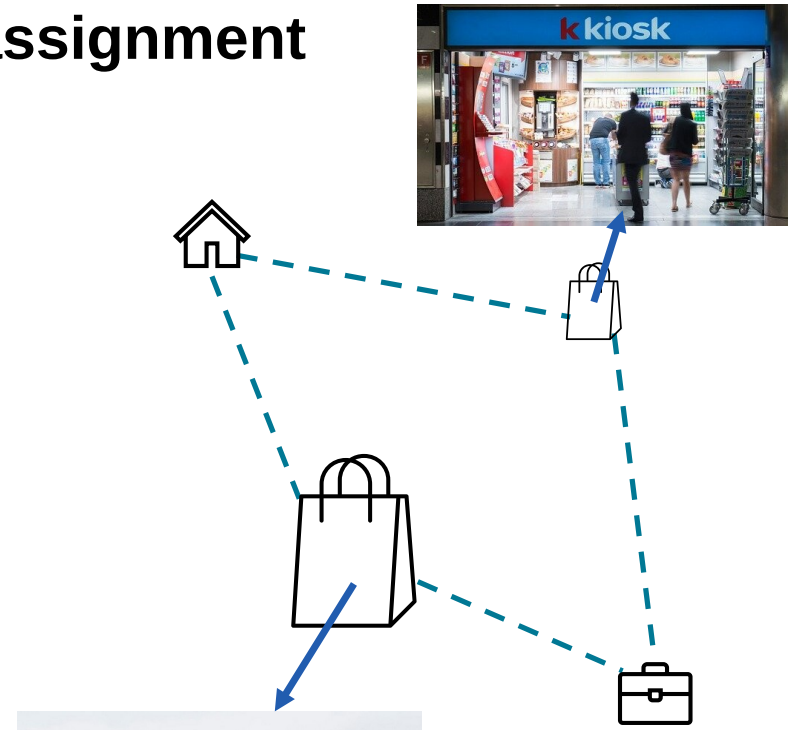
Eqasim new features – Secondary location assignment

- **Roundtrip:** Select locations within a **distance percentile threshold** (per mode × purpose), reflecting typical observed trip lengths.
- **Non-roundtrip:** Use a scaled buffer based on the **distance between anchors and mode**, where the scaler is learned from data using the same percentile threshold. Candidate locations are those that fall within the overlapping buffer around both anchors.
- To allow **occasional long trips**, we also sample a small portion of locations outside the buffer (1–percentile).



Eqasim new features – Secondary location assignment

- Since secondary activities can cover a wide variety of locations, its attractiveness score will depend on the **location type**
- **Businesses:** number of employees for the entire building
  - For example, a mall will aggregate the employees from all stores into a single location.
- **Residences:** number of residents in the building
- **Parks:** area of the park polygon

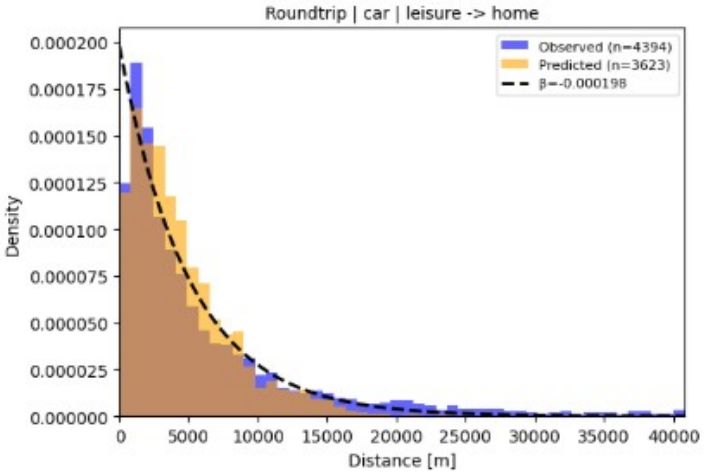


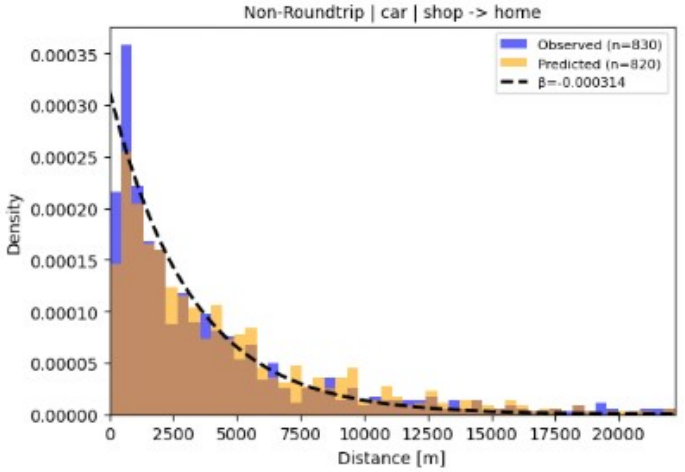
A large Migros would be considered more "attractive" than a small kiosk.

Eqasim new features – Secondary location assignment

- Each candidate location receives a utility score based on its **attractiveness** (employment, PT access) and the **distance from anchor points.**
- Longer distances are penalized with an exponential decay function, calibrated using an **exponential decay curve** separately for each mode, purpose, roundtrip triplet.
- The final mode–location pair is sampled probabilistically, weighted by its utility.

- Contact: anding@student.ethz.ch / balacm@ethz.ch





Eqasim new features – Mode-choice

Some people want to avoid using MATSim or are not interested in finding the equilibrium.

Trip and tour mode-choice models are directly integrated within eqasim.

The model parameters are estimated automatically using Biogeme, based on the code proposed by Sebastian Hörl and slightly updated.

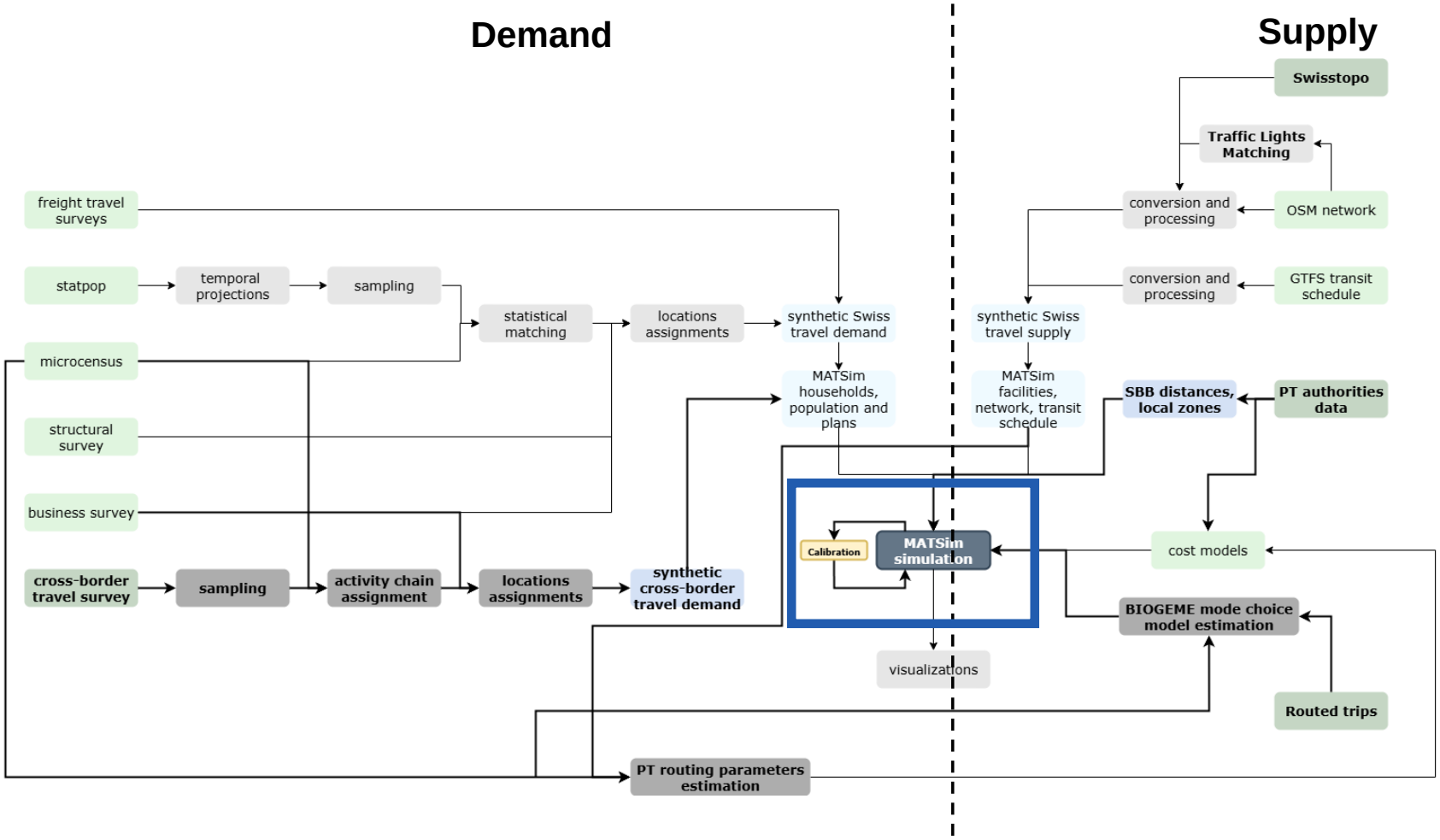
pt and car variables can be obtained from skim matrices, or directly obtained from MATSim or sourced from any other tool/library (e.g., GraphHopper, pandana).

Computing times and memory usage are significantly lower than when using MATSim's standalone mode-choice, even when obtaining pt travel times using MATSim.

The code is open source and currently available in the Switzerland pipeline.

Contact: Abdelkader Dib (abdelkader.dib@csfm.ethz.ch)

CMDP – Workflow

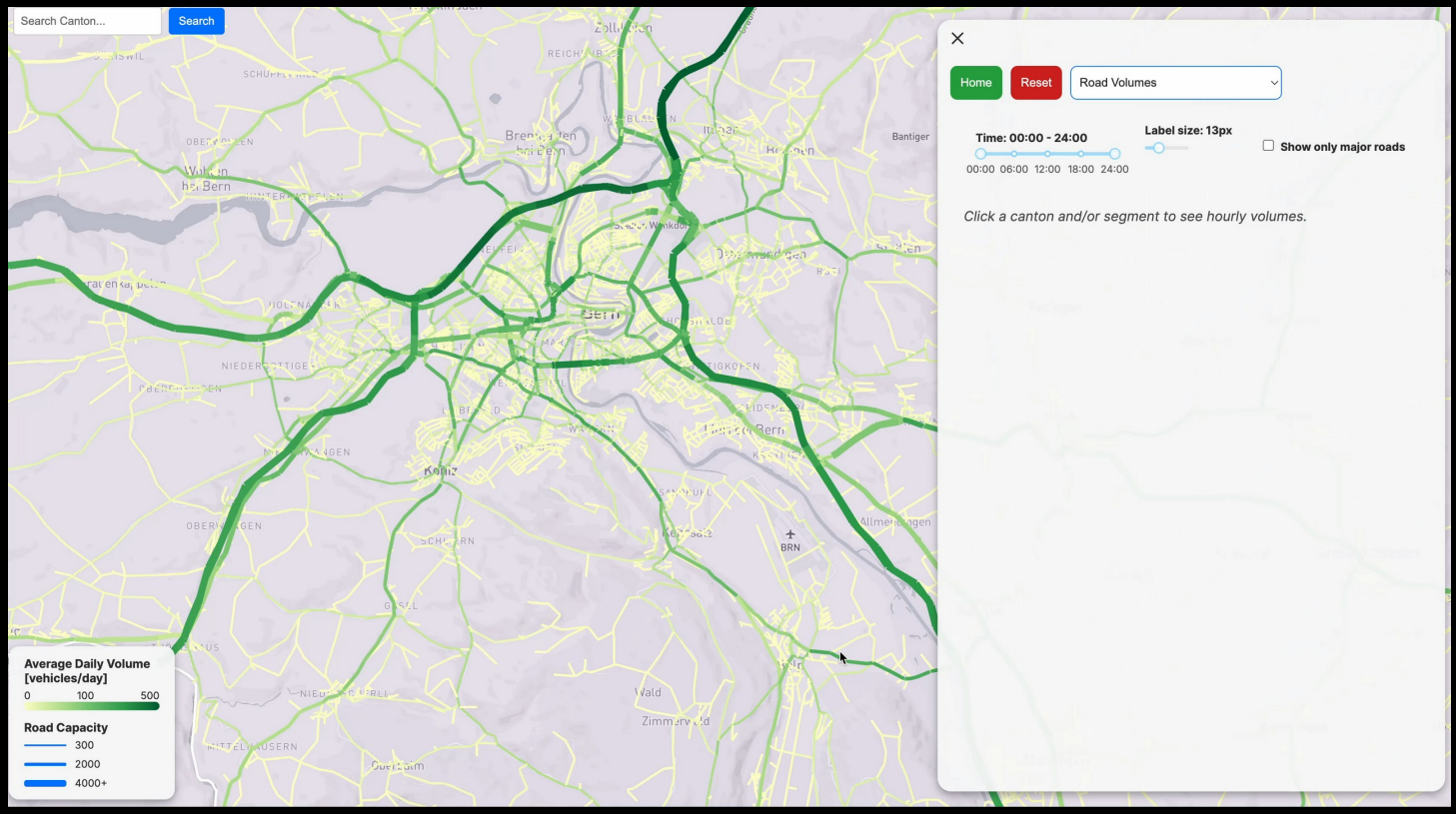


eqasim – Visualization

We are working together with our implementation partners on creating an open-source visualization of eqasim and MATSim outputs.

Live version: https://matsim-eth.github.io/webmap/

CMDP – Workflow



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- Dr. Aurore Sallard
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- tpg: Dr. Daniel Reck, Myriam Bris, Dr. Nicola Ortelli, Dr. Cloe Cortes
- tl: Dr. Martin Repoux
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