Incorporating "Mental Maps" in Route Choice Modeling: Preliminary Ideas

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Outline

- Background
- Methodological directions
- Data
- Preliminary results and applicability
- Conclusion

Route choice

Maybe the most challenging component of travel behavior.

- High requirements in data;
- Physical overlap of paths;
- Size and composition of choice set.

Find ways to facilitate route choice modeling and incorporate behavioral aspects.

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Motivation

- "The concept of path, which is the core of a route choice model, is usually *too abstract* for a reliable *data* collection process." (Frejinger, 2008)

- "People are in general able to identify a *sequence of locations* that they have traversed, but have difficulties describing a full path in detail." (Frejinger, 2008)

- "…in describing the neighborhood between her house and her school a young child typically will draw a map by starting at her home and filling in places as though walking from home to school. Her *cognitive map* is organized along a path in which one landmark follows another." (Golledge, 1999)

Anchor points (APs)

Dual role in the transportation environment:

- Organizing elements of peoples cognitive maps
- Wayfinding

Anchors can be demarcated in:

- Common anchors
- Individual (personalized) anchors:
  - Home;
  - Work;
  - Individual-specific *landmarks* (linked to activity patterns).

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From paths to anchor point sequences

- Being in the shoes of the drivers motivates a less rigid definition of paths.

⇒ Representation –and modeling– of "paths" in a higher conceptual level as sequences of *anchor points*.

⇒ Not a path anymore but an anchor point sequence.

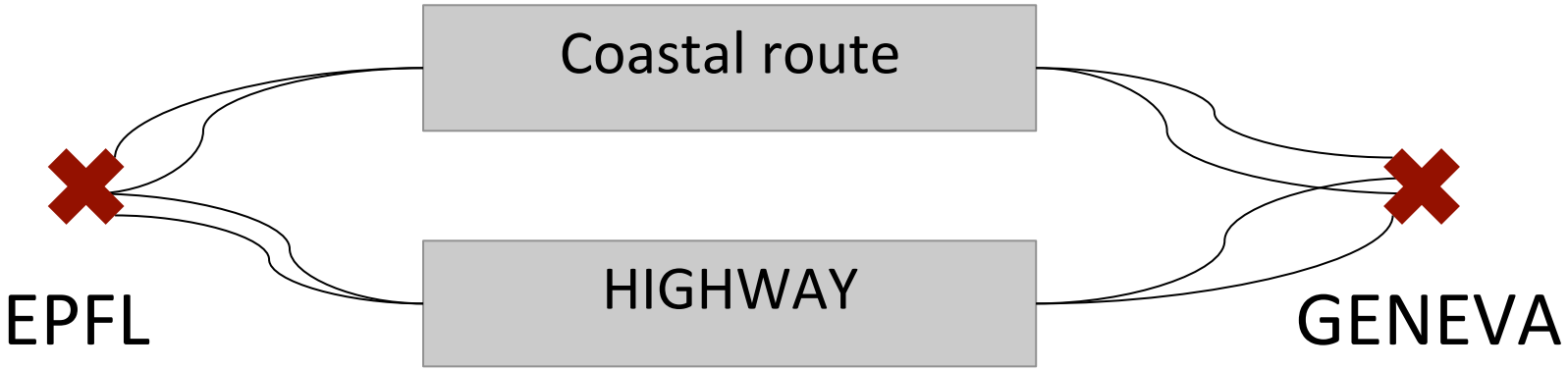
✓ Break down the combinatorial complexity.

Objective

- Introduce the idea of the framework;
- Briefly describe the data;
- Get your feedback..!!

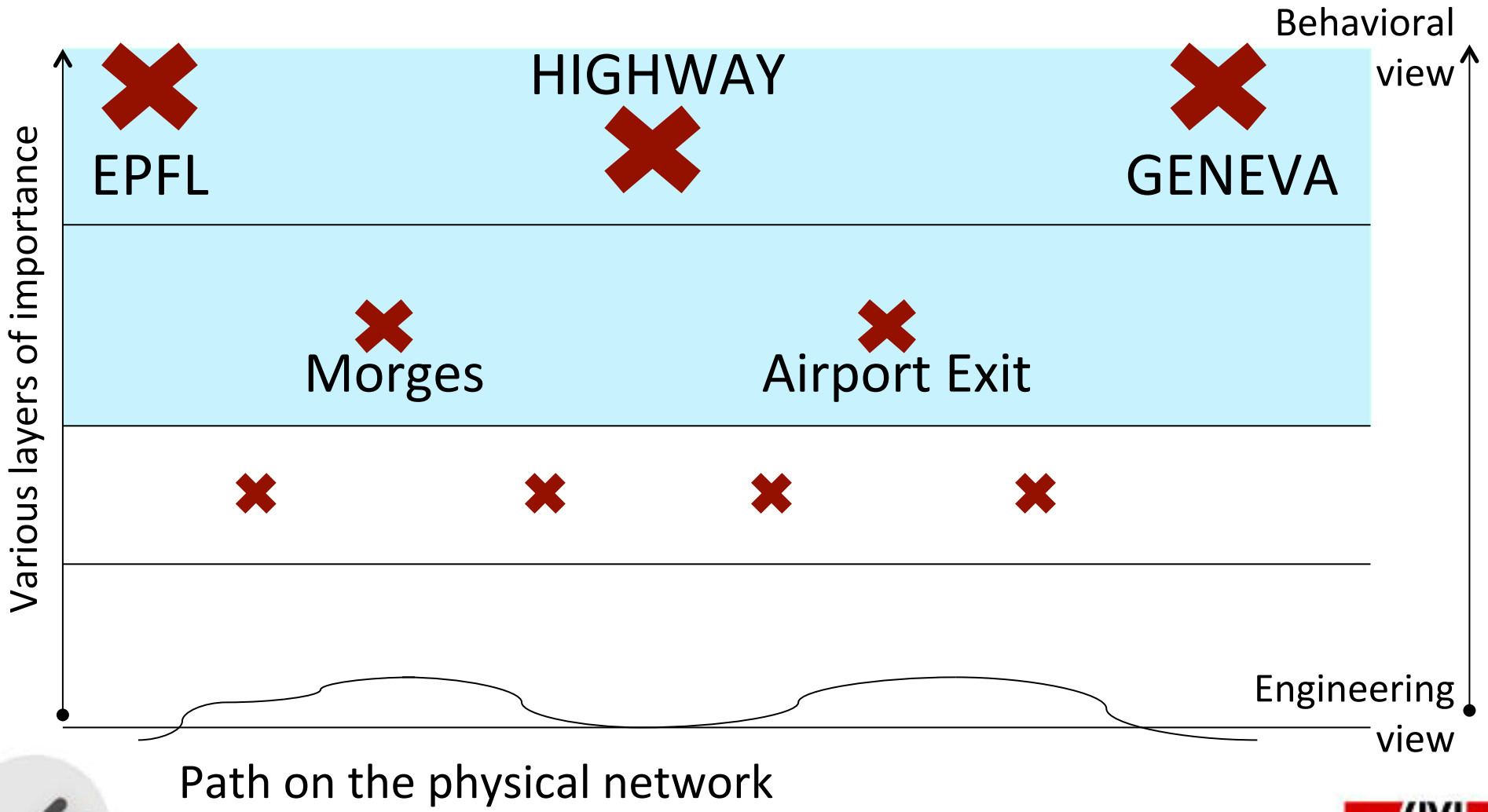
Modeling route choice in a higher level

What are we interested in is individual's higher level decision: from EPFL to Geneva through the highway...



..conditional on that there is a path decision (observed path). This will be simplified…

From network to mental map



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Mental map

- AP sequences: set of artificial alternatives
- List of APs
- Need to formally define APs- operationalization of concepts:
  - Various levels of abstraction.
  - Combination of a methodological and a behavioral approach.

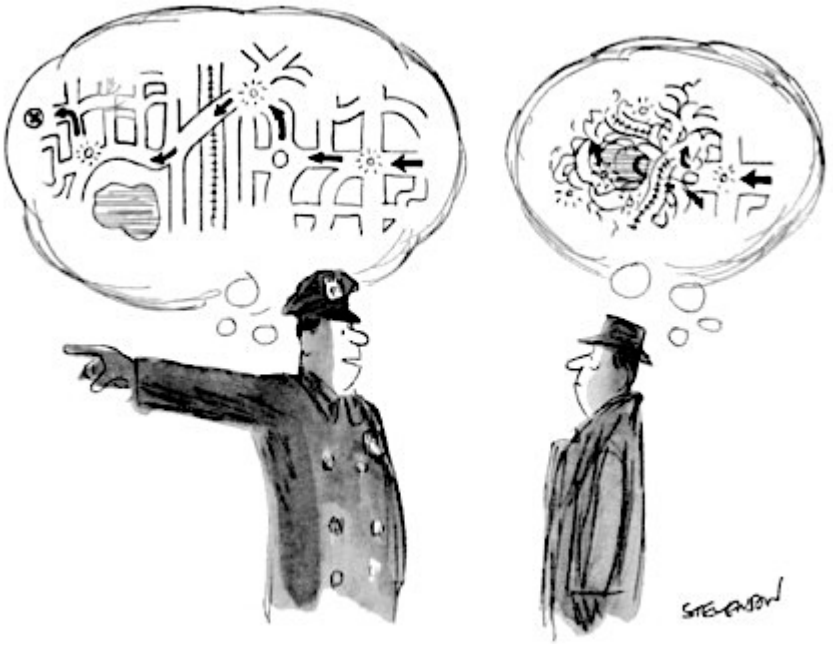
Building the mental map…

Behavioral input:

- Survey people

Methodological input:

- Data: frequency
- Land use, POI locations
- Network attributes: connectivity

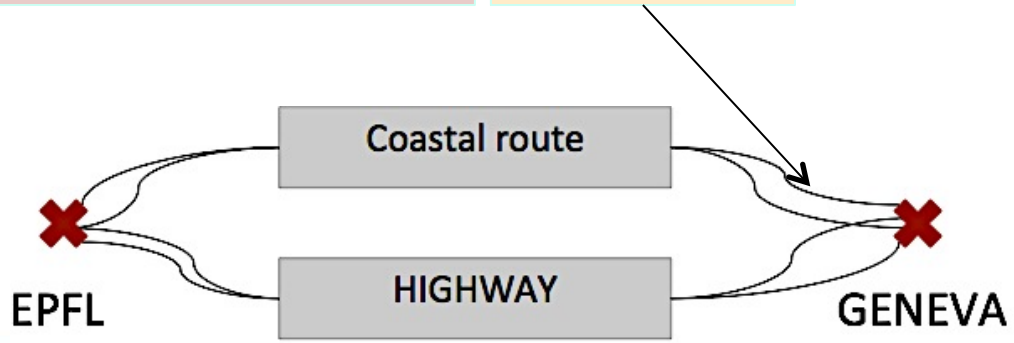


Route choice modeling framework (cont.)

We build on the route choice framework developed by Frejinger (2008), and further developed by Chen (2013).

✓ Probability of observing path p given the set of AP sequences $C\{AP\}$ is:

$$\mathrm{P}_n\left(p \mid C\{AP\}\right) = \sum_{AP \in C} \mathrm{P}_n\left(AP \mid C\{AP\}; \beta\right) \cdot \mathrm{P}_n\left(p \mid AP\right)$$



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Route choice modeling framework (cont.)

Then, the probability of reproducing observation i of traveler n given $C\{AP\}$ is decomposed as:

$$P_n\left(i \mid C\{AP\}\right) = \sum_{p \in P_n} \sum_{AP \in C} P_n\left(i \mid p\right) \cdot \mathrm{P}_n\left(AP \mid C\{AP\}; \beta\right) \cdot \mathrm{P}\left(p \mid AP\right)$$

i: observation i.e. a sequence of GPS records;

p: the actual path on the physical network;

AP: a sequence of APs.

Overview of the collected data

Nokia Data Collection Campaign (LDCC), 2009-2011

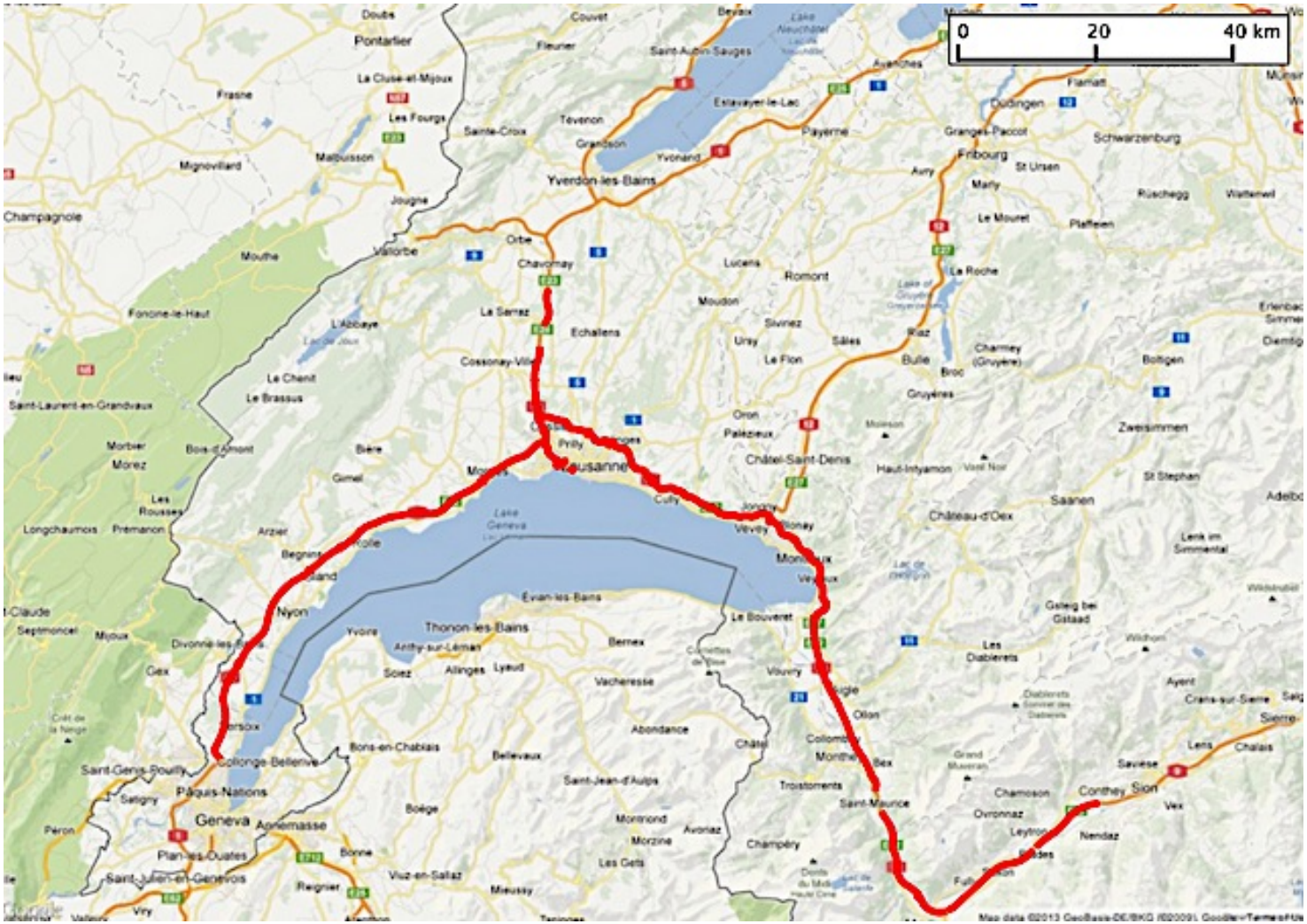
- ~200 Nokia N95 smartphone users in Geneva Lake area
  - GPS points;
  - Nearby Wi-Fi and blue tooth access points;
  - Acceleration records;
  - SMS and call log records;
  - calendar entries; …
- Basic socio-economic information for 158 users
- Home, work and main grocery addresses for 21 users

Previous work on the data (Chen, 2013)

- Challenges related to measurement errors and low frequency in reported data.
- Framework to infer paths:

  Probabilistic path observations comprising of sets of candidate paths, each associated with a corresponding measurement likelihood.

Most frequently visited links



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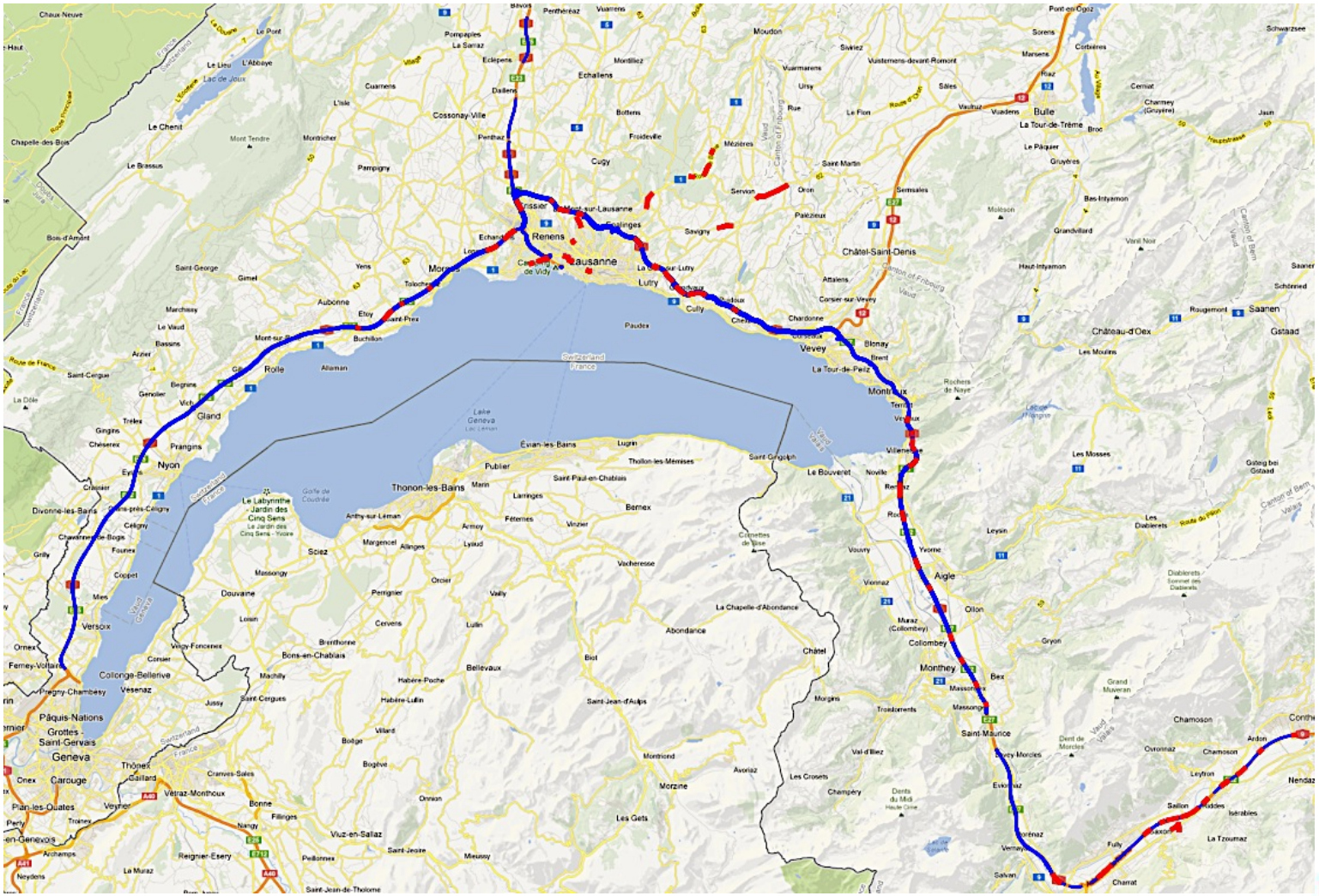

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Conclusion

- Several issues to be addressed in the base of the framework.
- Need to deal with the limitations of the data as well.

✓ Simpler, more realistic representation of the man-environment interface.

✓ Advantages:

- Size of the choice set
- Simpler correlation structure; perceptual correlation

☞ First steps underway:

- Literature review and definition appropriate terminology
- Conduct a survey; questionnaire or interviews?
- Explore the data

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