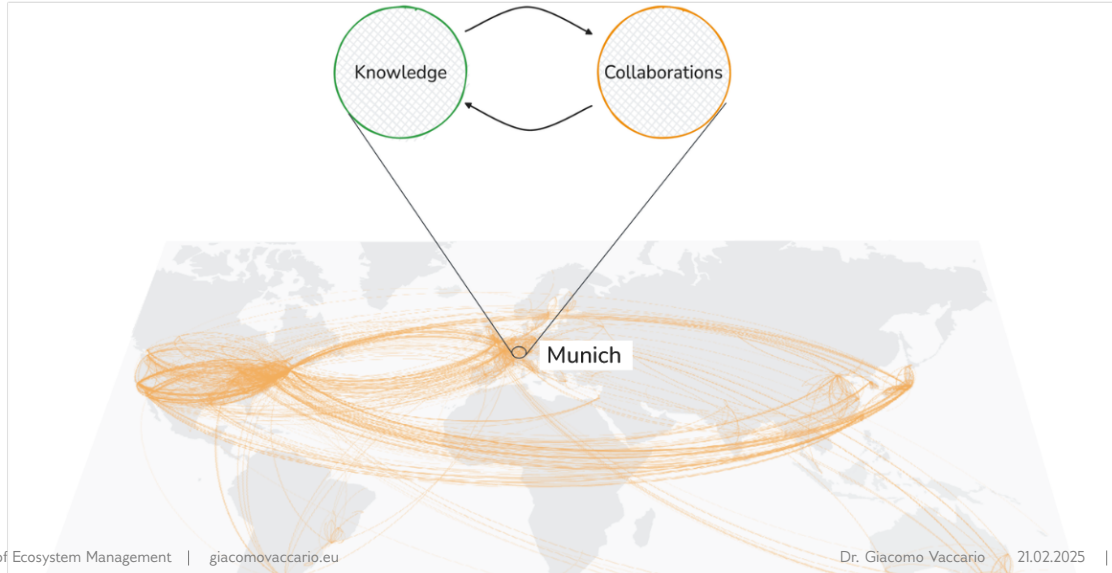
ETH zürich

Knowledge on the move

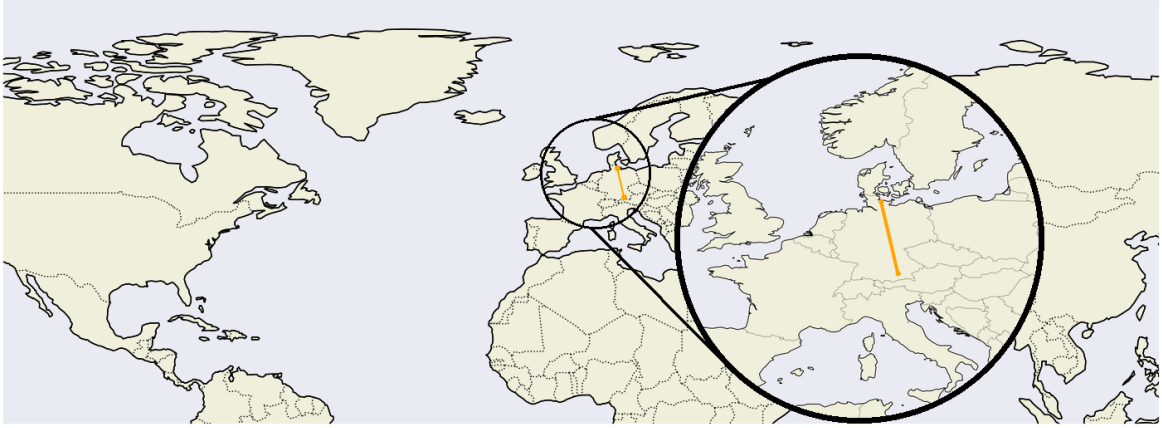
Reconstructing scientists' mobility network

Dr. Giacomo Vaccario

Collaborations and knowedge in the geographic space



Career trajectories from bibliometric data



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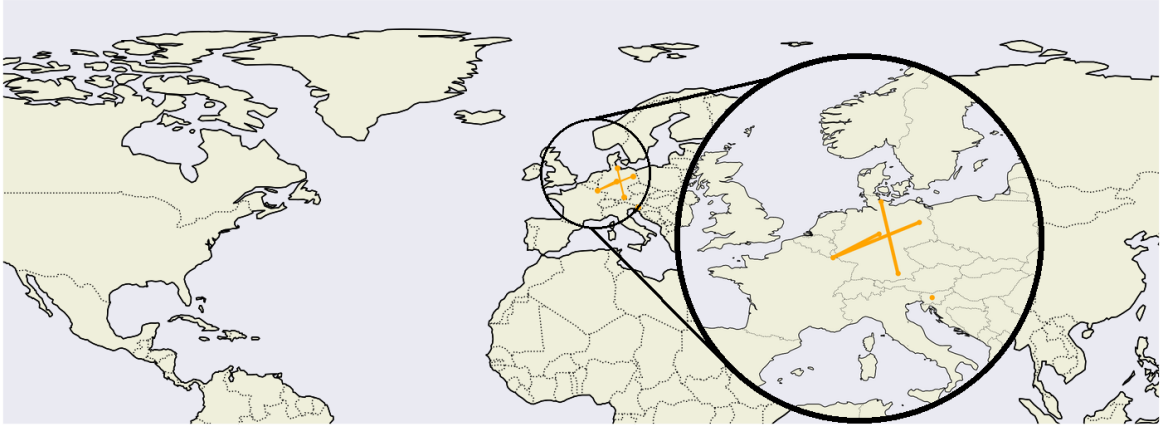

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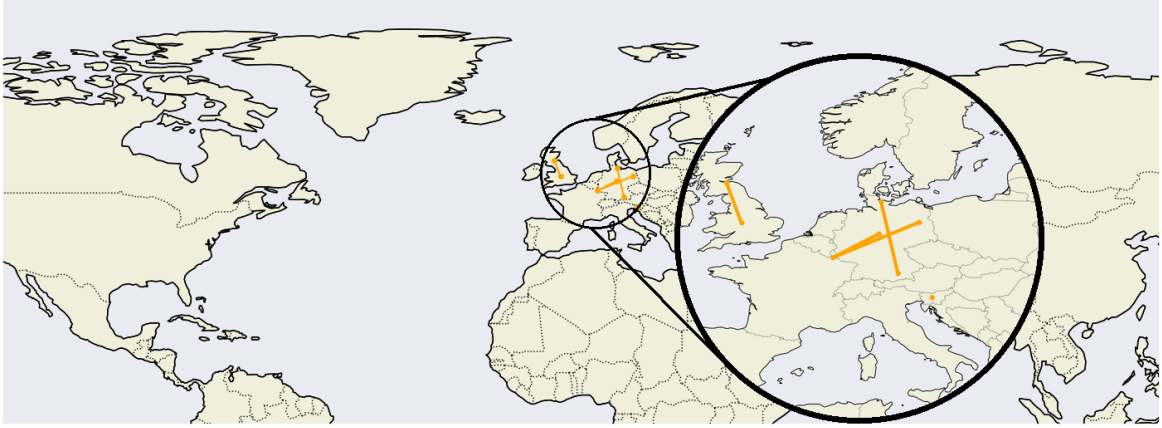

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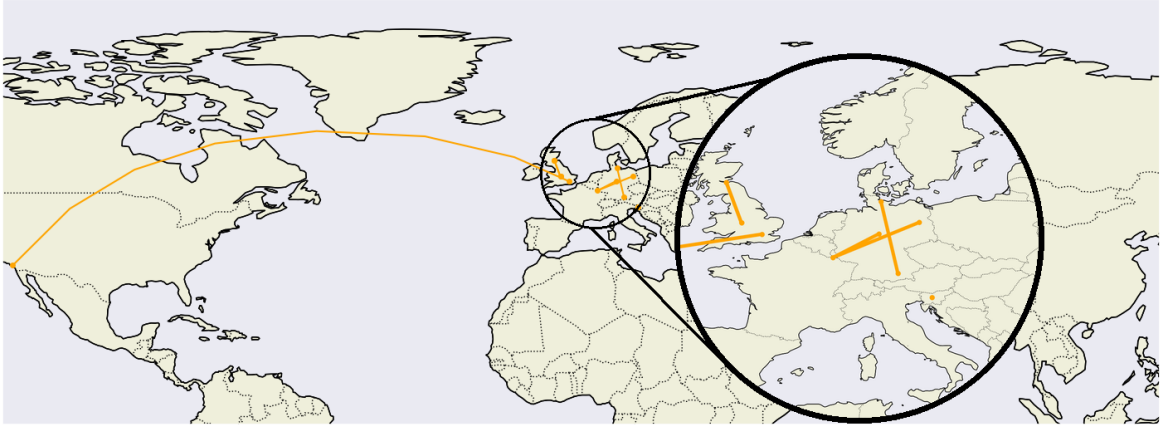

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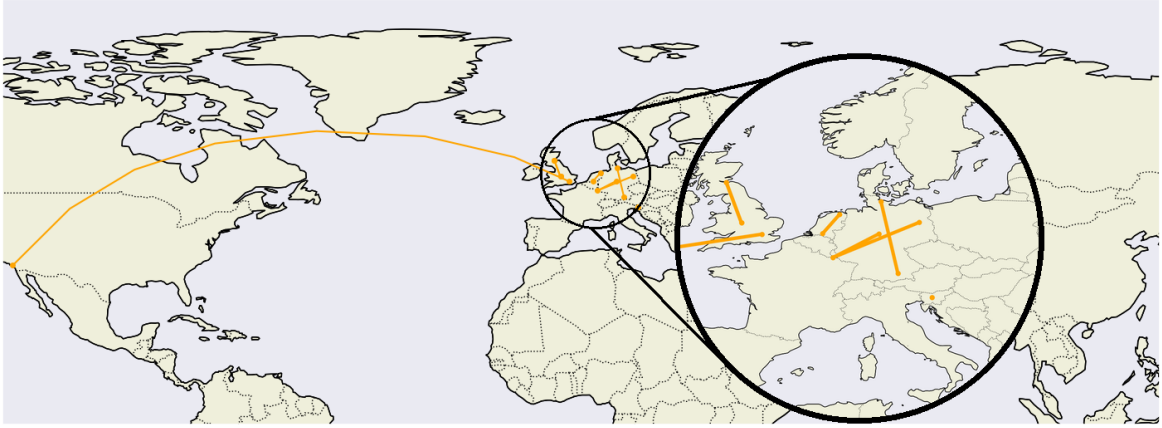

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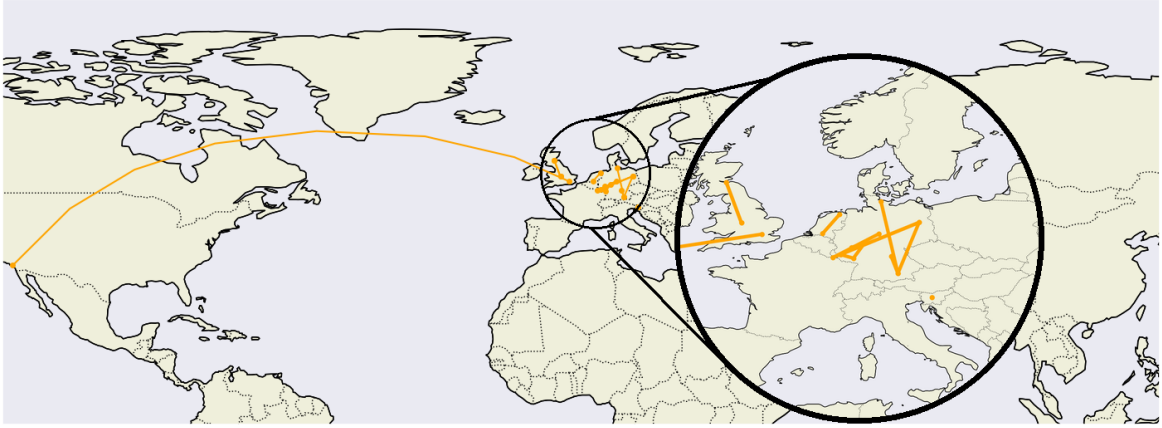

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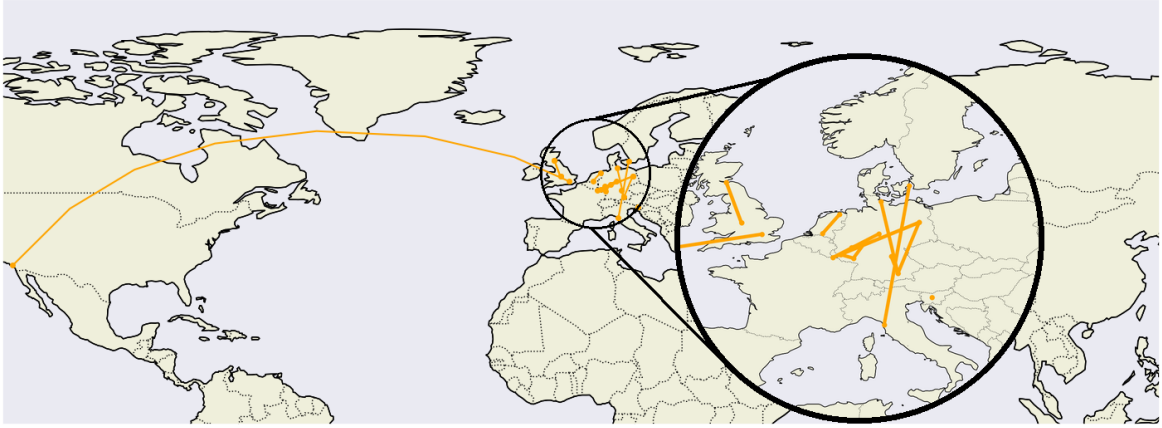

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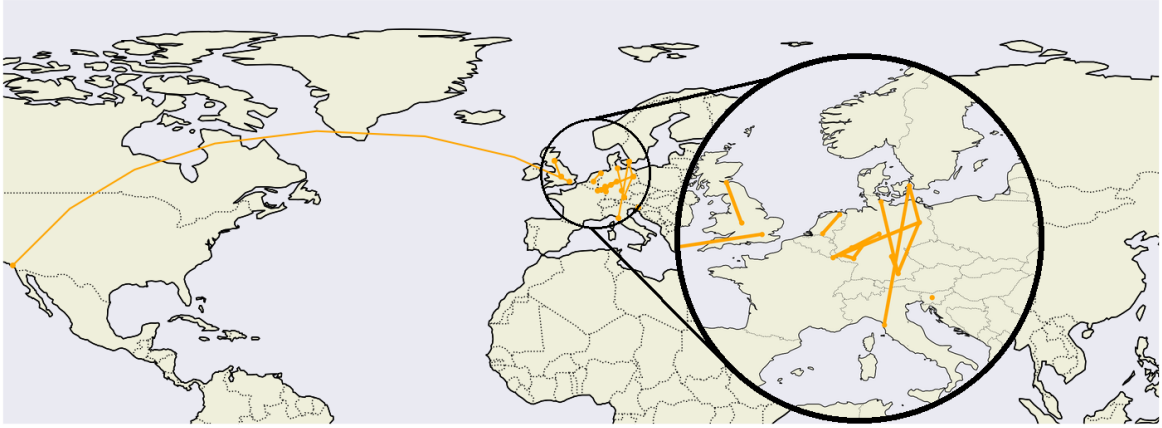

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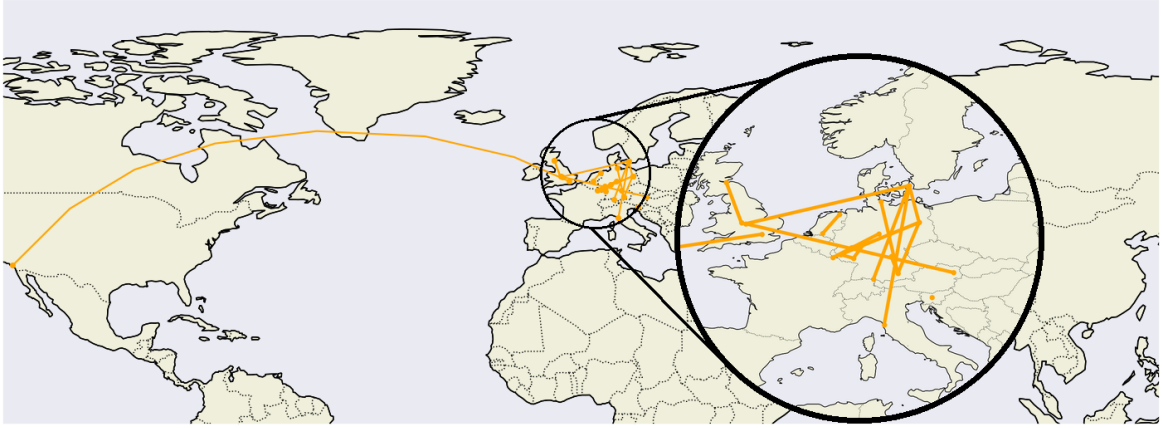

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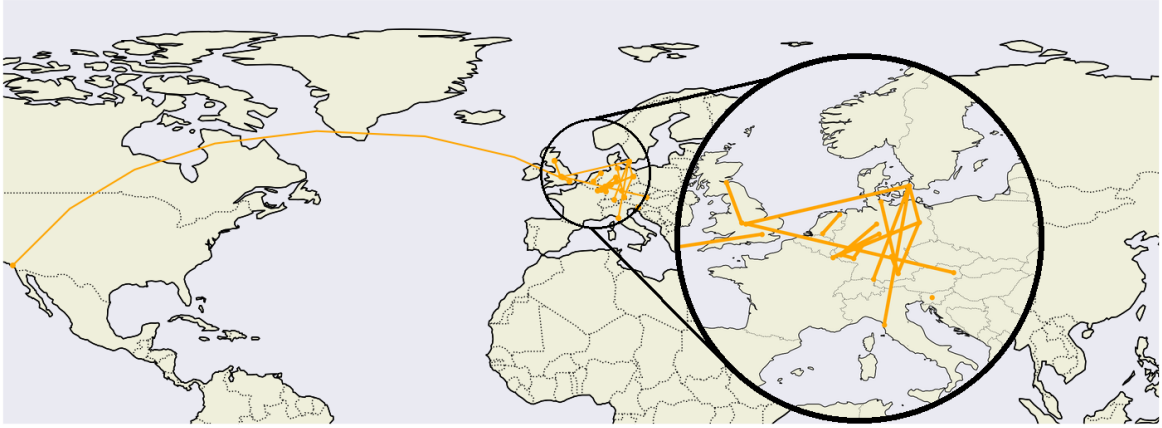

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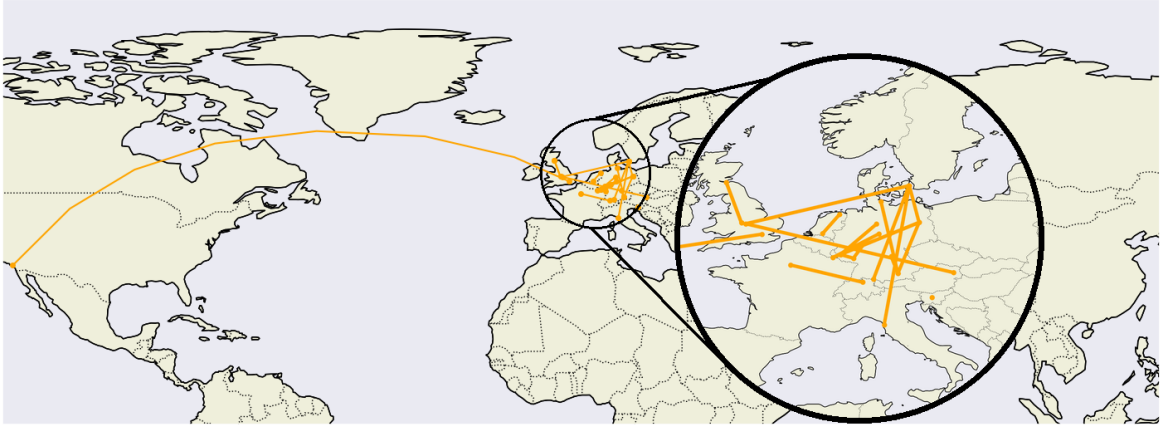

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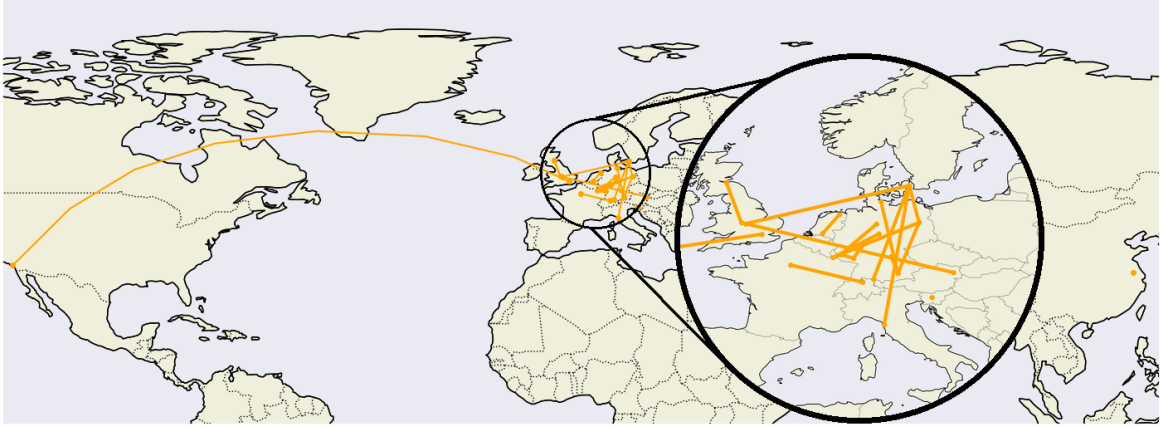

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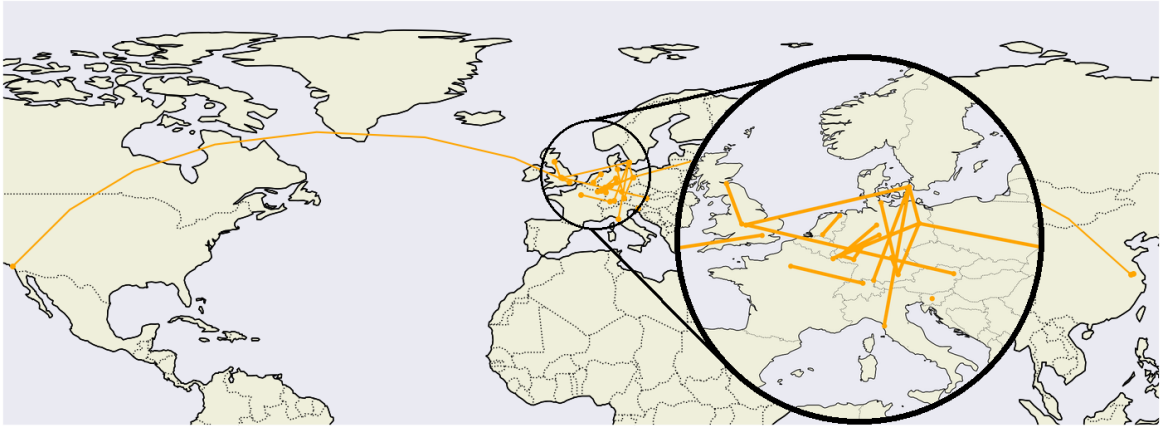

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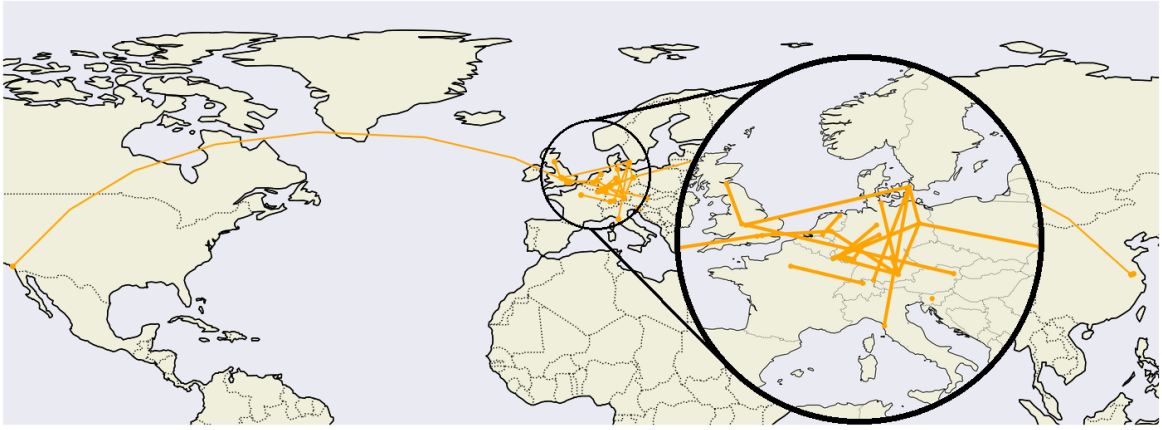

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Mobility networks at city level – Workshop Science of Science

- 32 cities → nodes
- 22 presenters → 16 trajectories
- Distance traveled
  - mostly < 1000 km
  - gap between 2000 to 8000 km
  - two around 9000 km
- Path lengths:
  - pick at 4
  - decrease quickly

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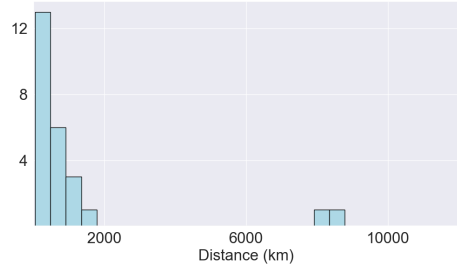
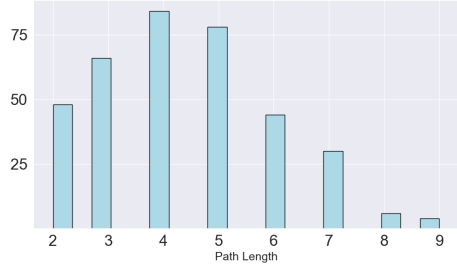
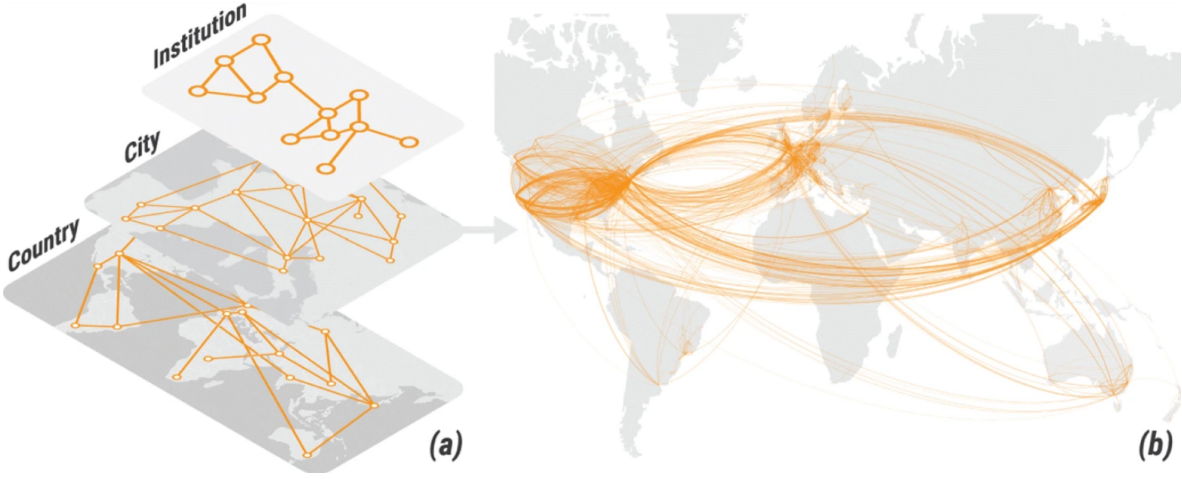


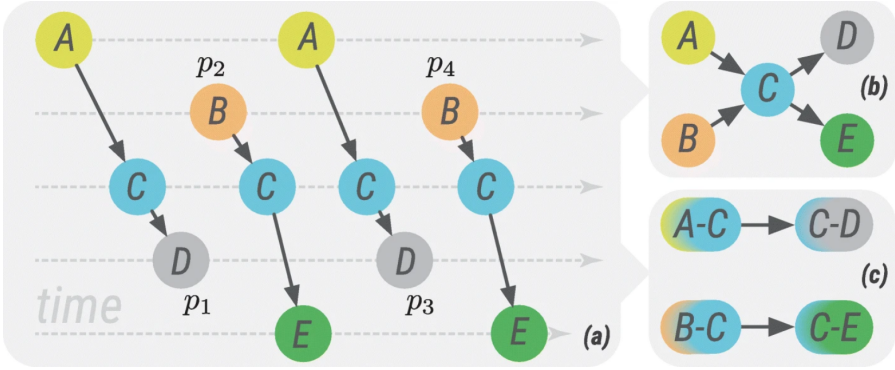


Scinetists' transfer at institution, city and country level

- Scientists → Tacit knowledge
  - MEDLINE: 3.5 million career trajectories



Representing career trajectories



Representation matters – An example

(a) Four career trajectories between the location *A*, *B*, *C*, *D* and *E*

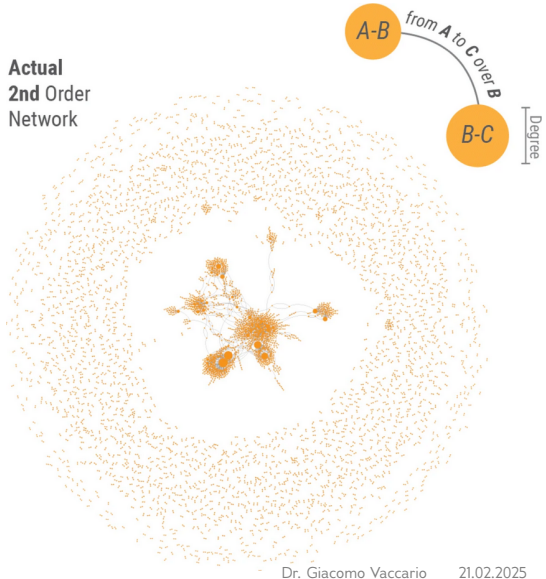
(b) **Network** → Scientists can move freely from *A* to either *D* or *E* via *C* → **WRONG!**

(c) **Second-order** network → two corridors → **CORRECT!**

Scientists' mobility: Corridors Vs Networks

The aggregation level matters

- Institution and country
  - ⇒ second-order
  - ⇒ knowledge corridors
- Instead at City level
  - ⇒ network
  - ⇒ scientists can move "freely"
  - ⇒ no evidence for memory



Mobility network at city level

- MEDLINE: 3.5 million career trajectories

Reproducing mobility network: Data-driven agent-based model

Data

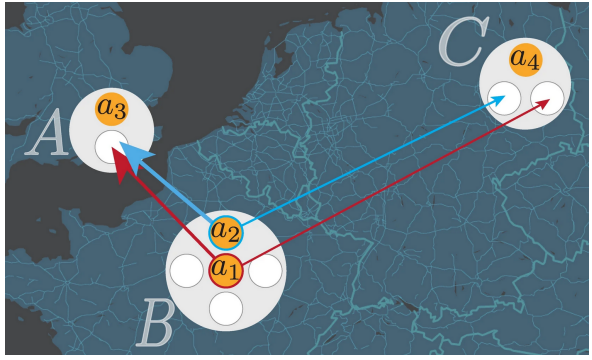
- MEDLINE: scientists' publications
- SCIMago: impact factors

Model entities

- **Scientists** prefer **closer**location with higher fitness → weight of distance *b*
- **Locations** prefer scientists with higher fitness → selectiveness *s*

Constraints

- **Limited space** per location
- Scientists **propose** to move
- But locations **decide** to accept



Vaccario, G., Verginer, L., & Schweitzer, F. (2021). Reproducing scientists' mobility: a data-driven model. *Scientific Reports*

Reproducing mobility network: Data-driven agent-based model

Network level properties

- Degree distribution
- Clustering coefficient
- Path lengths
- …

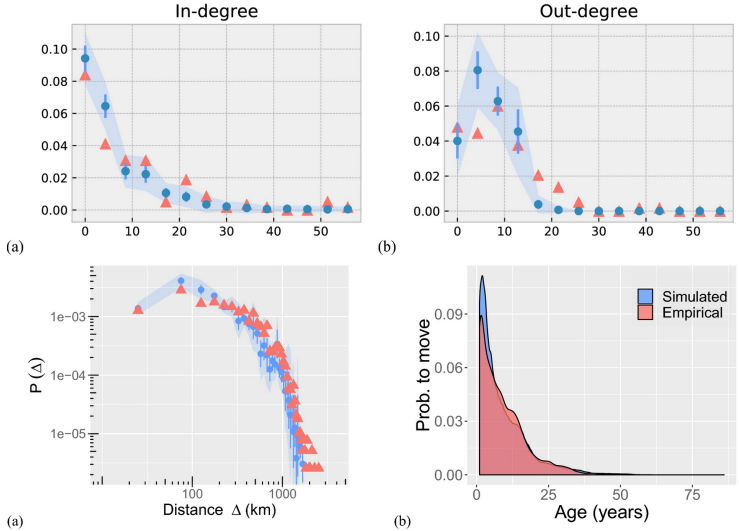
Scientist level properties

- Traveled distance
- Academic age when moving

Optimal parameters

- Learn about status quo

e.g. $b = 0.5 \rightarrow$ sublinear importance distance



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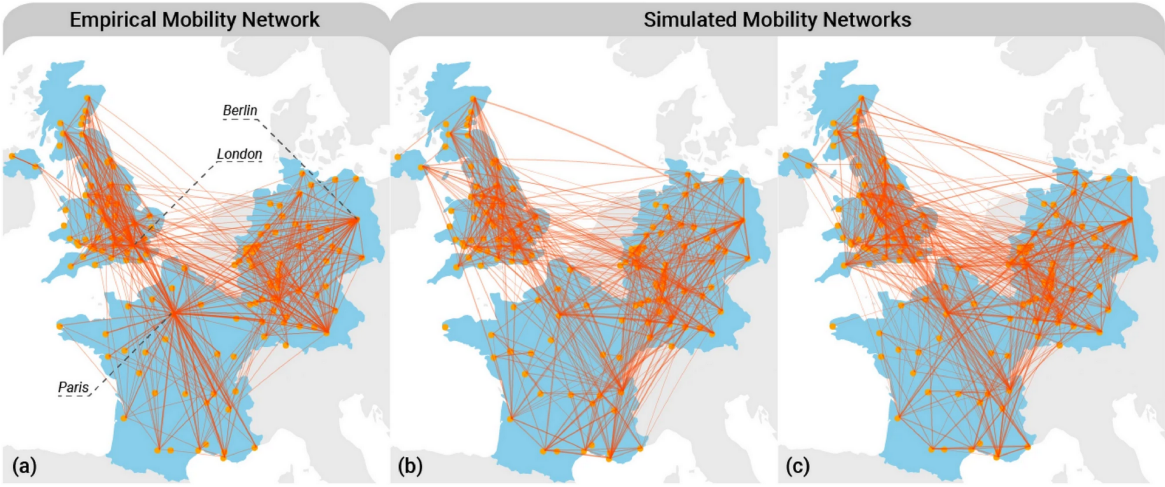

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Conclusions

- Tacit knowledge is constrained in the geographic space
  - Memory in career trajectories
- Higher-order networks represent these constraints as topological properties
  - Knowledge corridors at country and institution level
  - Brain circulation at city level
- Data-driven agent-based model
  - reproduce the mobility network
  - parameters inform about drivers