Based on the DARUMA project (2021-2024)

京都大学 KYOTO UNIVERSITY   HITACHI Inspire the Next   名古屋大学 NAGOYA UNIVERSITY

Technische Universität München   MŰEGYETEM 1782   UNIVERSIDAD COMPLUTENSE MADRID

A Daruma doll is a Japanese traditional doll, symbol of resilience

- Japan: Japan Science and Technology Agency (JST)

- Germany: Federal Ministry of Education and Research (BMBF)

- Spain: Agencia Estatal de Investigación (AEI) - State Research Agency

- Hungary: National Research, Development and Innovation Office (NKFIH)

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Project website: https://concert-japan-daruma.github.io

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Aim: Help cities better support the impact of events and crisis, and "return to normality" as fast as possible

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MOST CENTRO NAZIONALE PER LA MOBILITÀ SOSTENIBILE

POLITECNICO MILANO 1863

Components

- Conceptual framework

- (Mostly) opportunistic data collection
  - Google Popular Times (GPT)
  - Social Media data (Twitter/X, Facebook, …)
  - Floating car data
  - Mobile phone data

- Artificial Intelligence techniques
  - Transfer learning
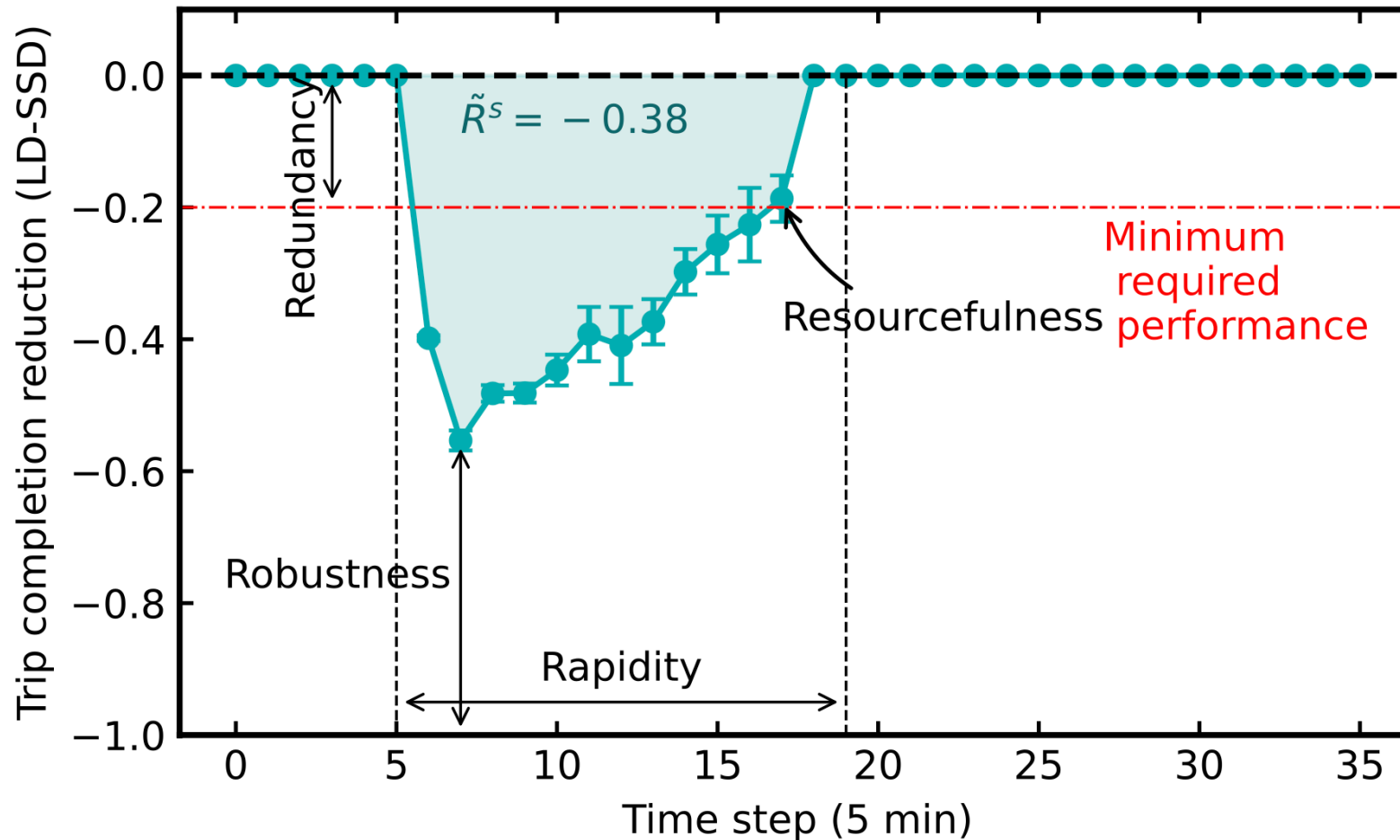 - Sentiment analysis
  - …

Components

- Conceptual framework **Understand**

- (Mostly) opportunistic data collection **Measure**
  - Google Popular Times (GPT)
  - Social Media data (Twitter/X, Facebook, …)
  - Floating car data
  - Mobile phone data

- Artificial Intelligence techniques **Improve**
  - Transfer learning
  - Sentiment analysis
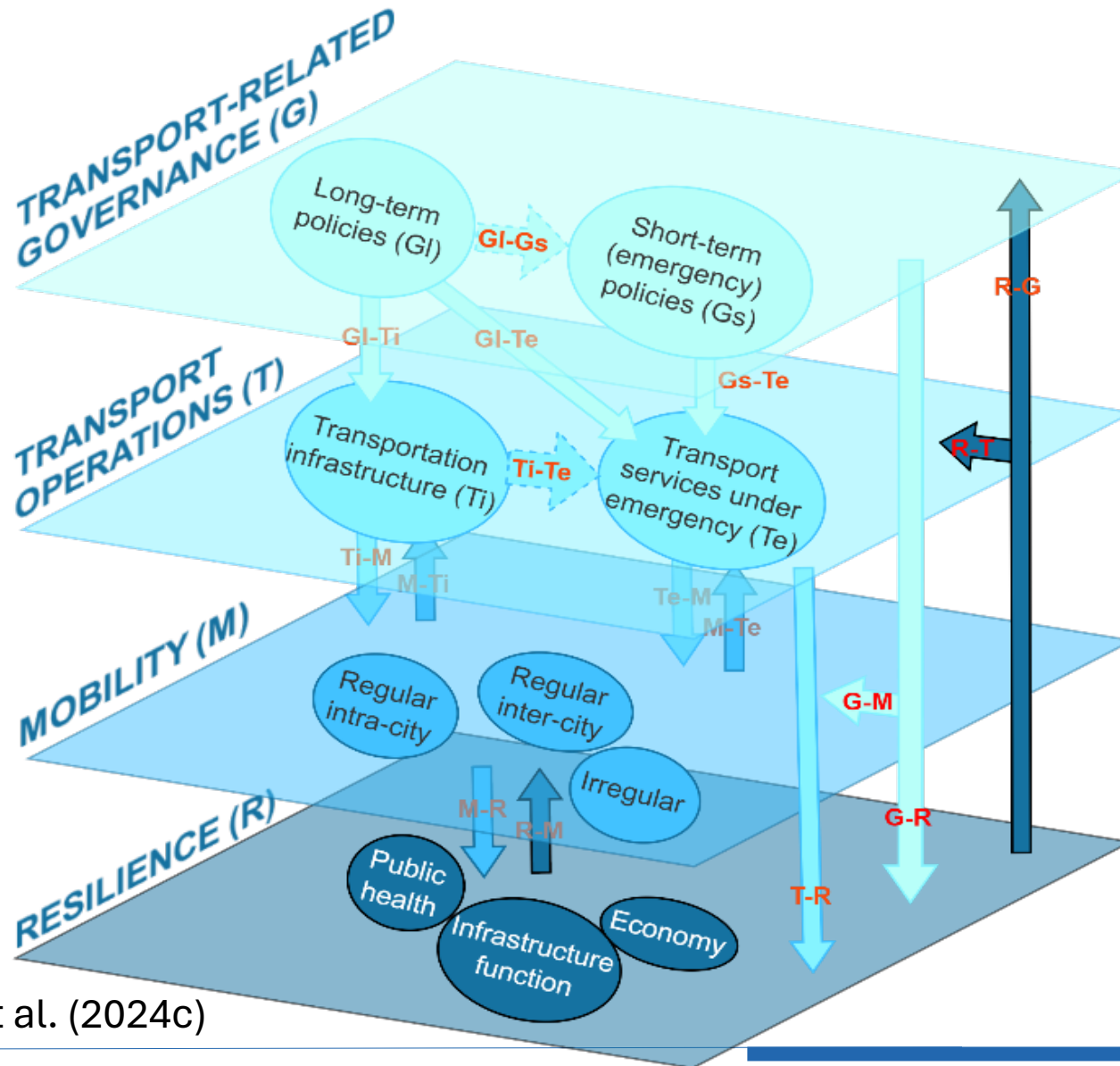 - …

Main properties and definitions of resilience

Lu et al. (2024b)

Conceptual framework

Lu et al. (2024c)

Example: Pandemic containment policies (transport-related)

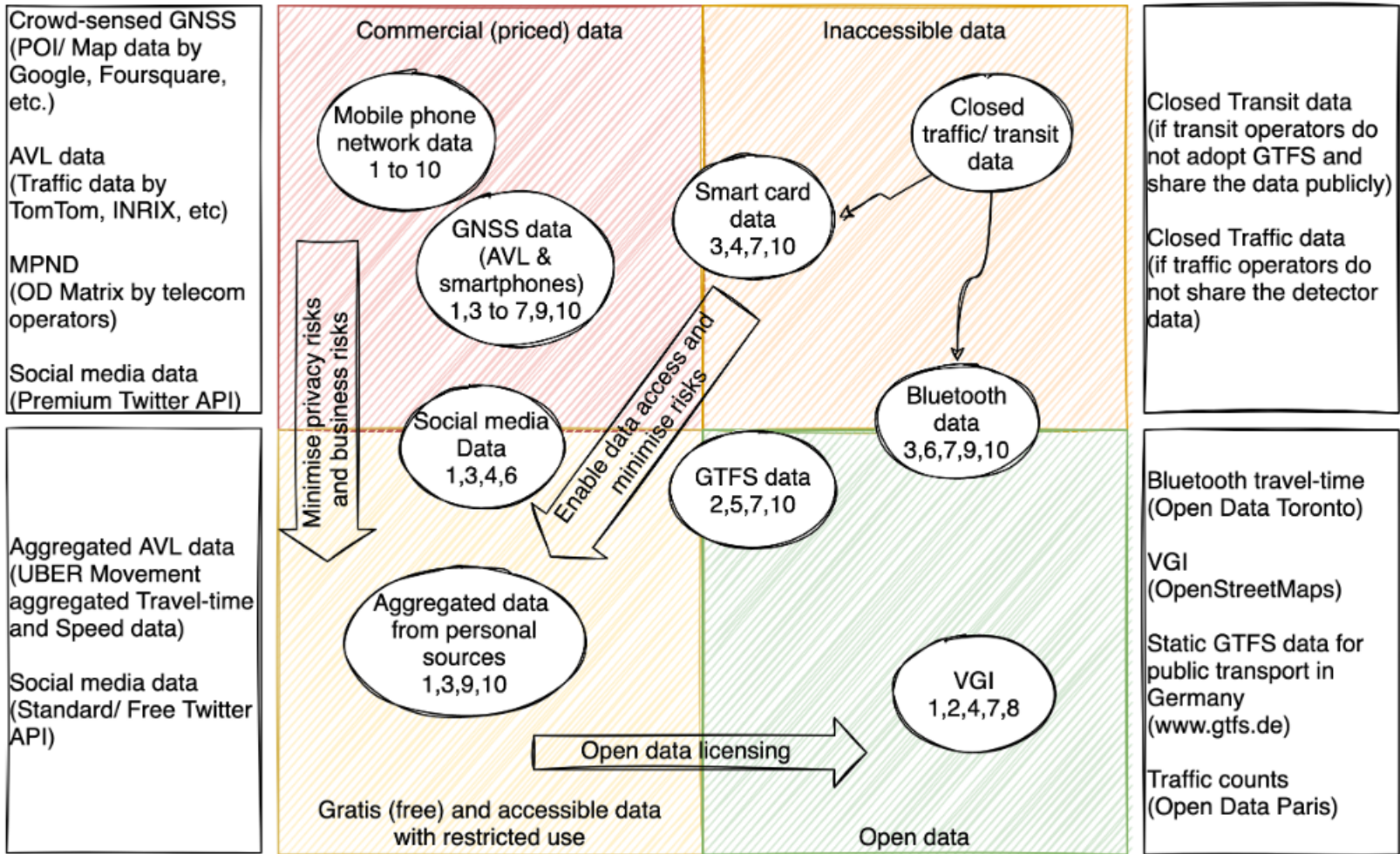| ID	Strategy	Effect
S1	Cancellation of international passenger flights	E1
S2	Reduction of intercity buses, trains, high-speed trains, planes, etc.	E1
S3	Cancellation of intra-city public transport operation	E2
S4	Publishing infection risk warnings, appeal citizens not to make non-essential trips	E2, E5
S5	Posting trajectories of the infected	E3, E5
S6	Daily disinfection of public transport vehicles	E4
S7	Wearing a mask and maintaining social distancing in public transport vehicles	E4
S8	Scale management of taxis	E2
S9	Stay-at-home orders	E2, E3
S10	Ride-sharing companies laid off management staff and froze driver sign-ups	E2
S11	Using taxis to provide point-to-point goods delivery to residents	E2, E3
S12	Offering free usage of city bicycles	E3
S13	Back-door-only loading policy	E3, E4
S14	Opening specific lanes to bicycle users	E3
S15	Improving the public transport information system	E3, E5

Lu et al. (2024c)

POLITECNICO
MILANO 1863

Policies categorisation and contribution to resilience properties
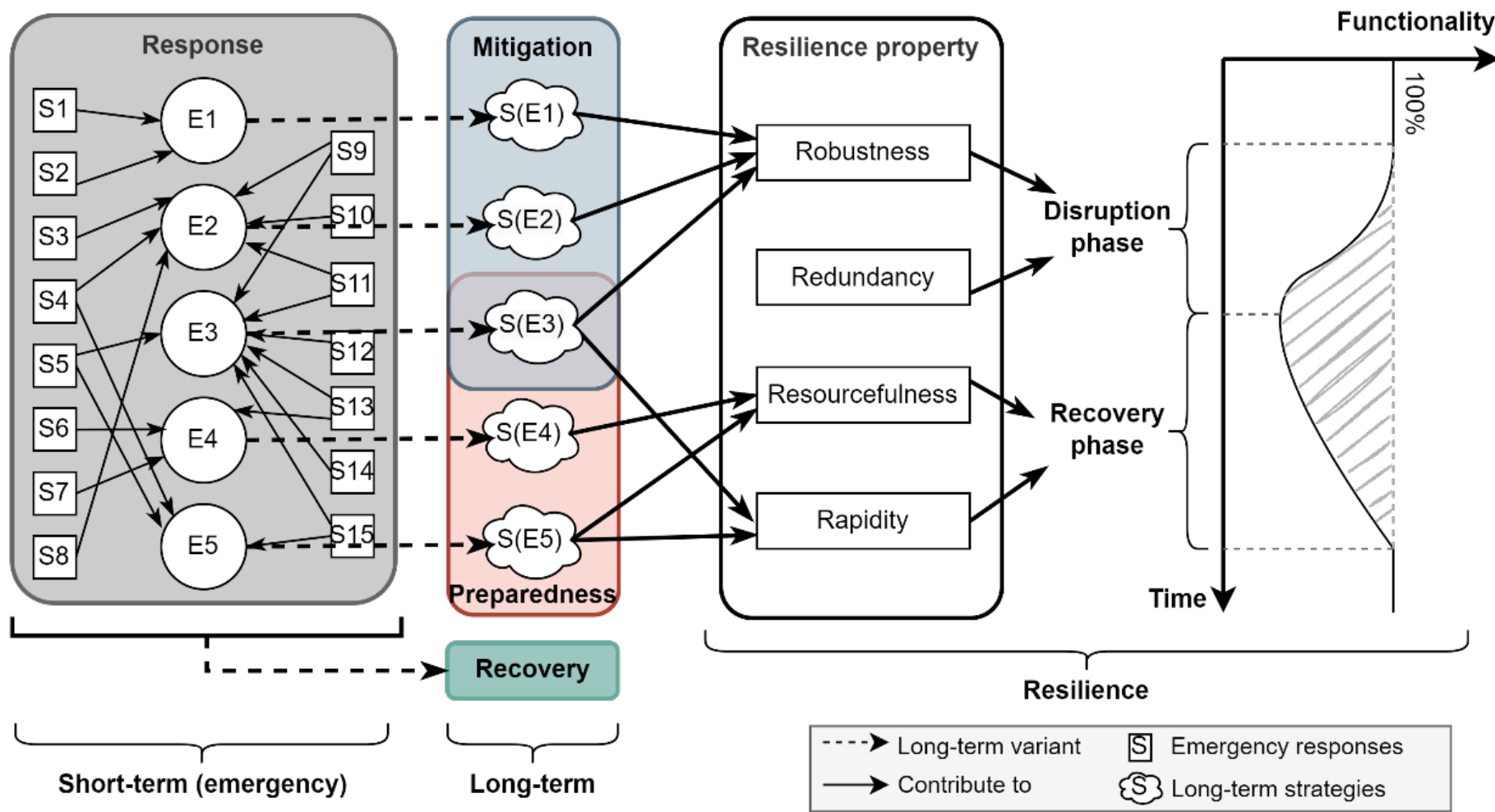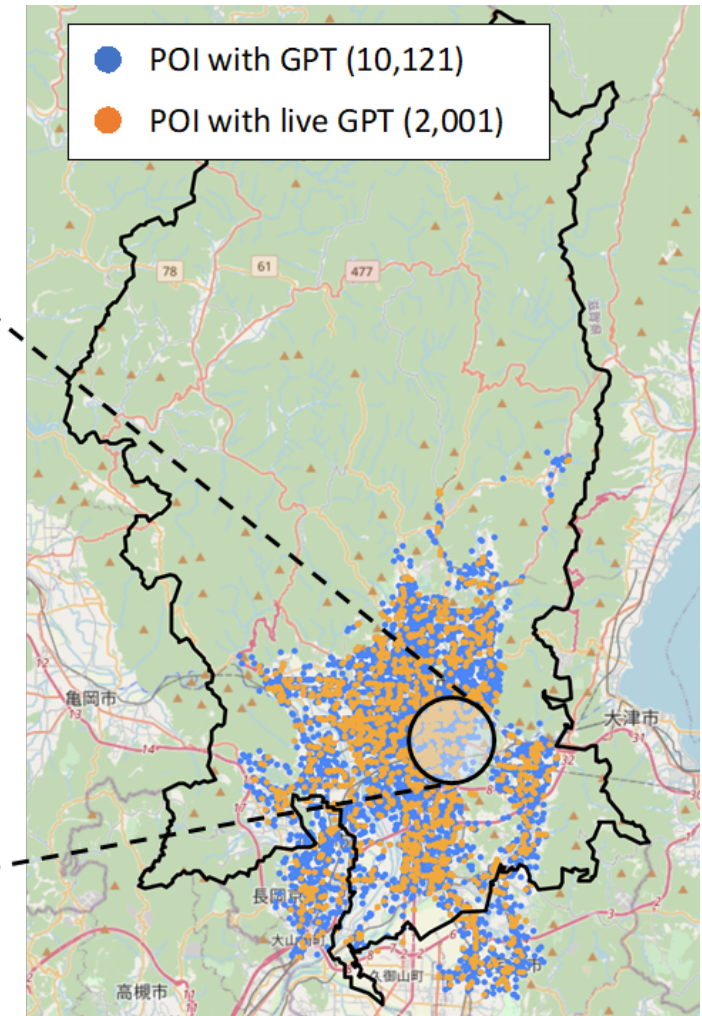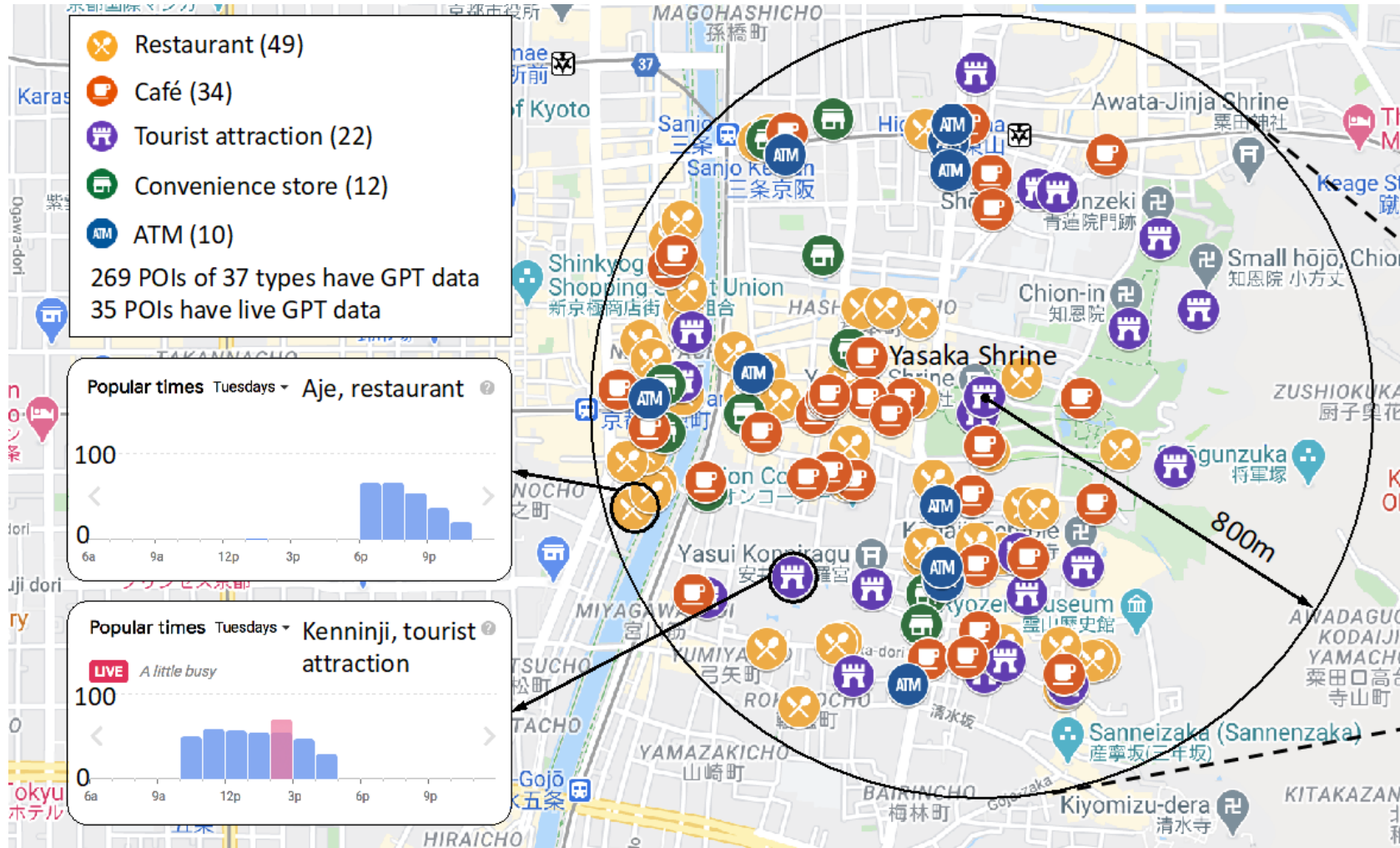

Lu et al. (2024c)

Key (Numbers in the circles represent modelling task):
1: Trip Generation, 2: Accessibility, 3: Trip Distribution/ OD flows,
4: Destination Choice/ Activity Spaces/ Trip Purpose,
5: Departure Time Choice, 6: Mode Detection, 7: Route Choice,
8: Network Modelling, 9: Traffic Speed, 10: Travel-time,

Crowd-sensed GNSS (POI/ Map data by Google, Foursquare, etc.)

AVL data (Traffic data by TomTom, INRIX, etc)

MPND (OD Matrix by telecom operators)

Social media data (Premium Twitter API)

Aggregated AVL data (UBER Movement aggregated Travel-time and Speed data)

Social media data (Standard/ Free Twitter API)

Commercial (priced) data

Inaccessible data

Mobile phone network data
1 to 10

GNSS data (AVL & smartphones)
1,3 to 7,9,10

Smart card data
3,4,7,10

Closed traffic/ transit data

Social media Data
1,3,4,6

Bluetooth data
3,6,7,9,10

GTFS data
2,5,7,10

Aggregated data from personal sources
1,3,9,10

VGI
1,2,4,7,8

Minimise privacy risks and business risks

Enable data access and minimise risks

Open data licensing

Gratis (free) and accessible data with restricted use

Open data

Closed Transit data (if transit operators do not adopt GTFS and share the data publicly)

Closed Traffic data (if traffic operators do not share the detector data)

Bluetooth travel-time (Open Data Toronto)

VGI (OpenStreetMaps)

Static GTFS data for public transport in Germany (www.gtfs.de)

Traffic counts (Open Data Paris)

Public availability and applications of prominent datasets used in transport modeling
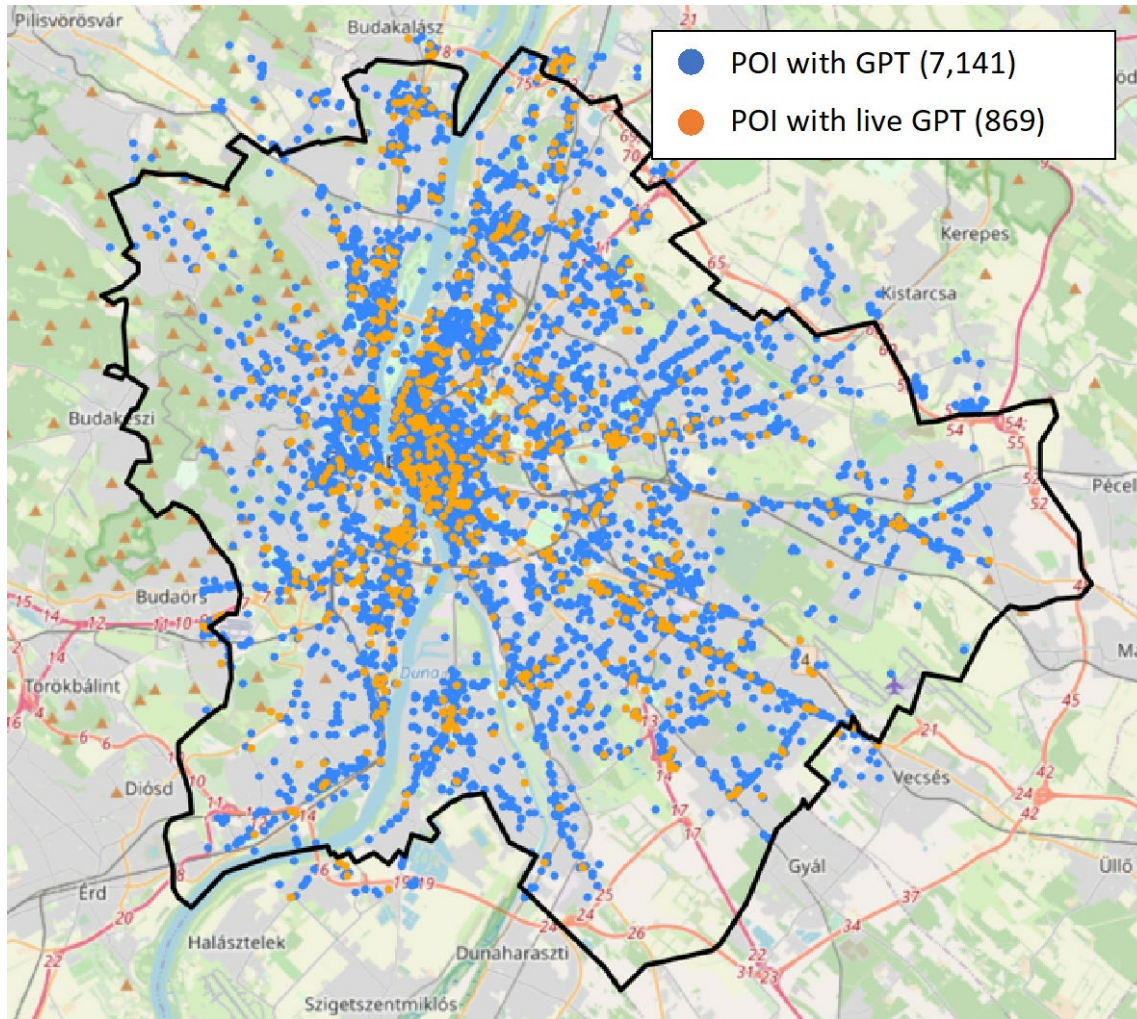
Mahajan et al. (2021b)

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An example: Google Popular Times (incl. live)

Sun et al. (2023)

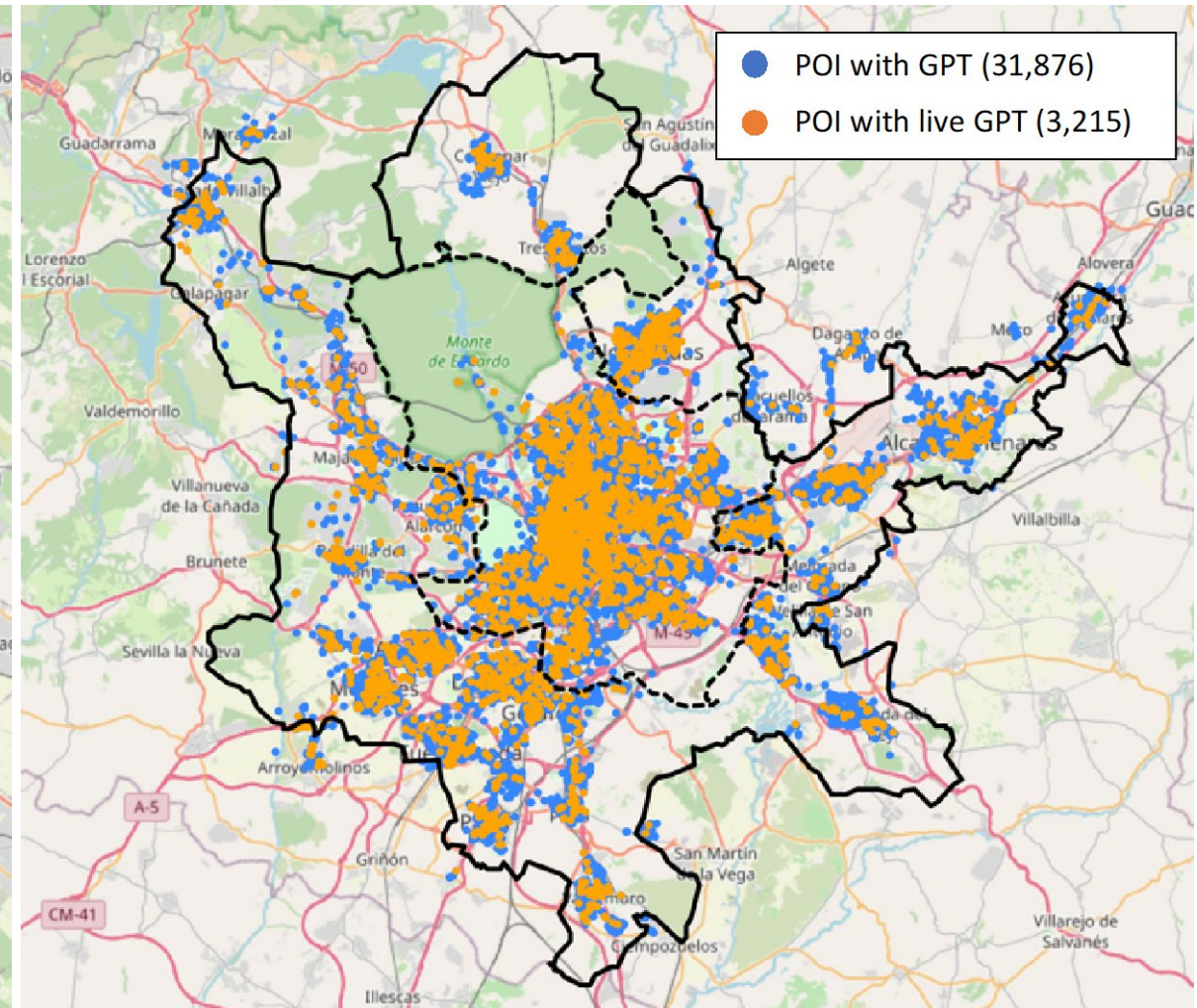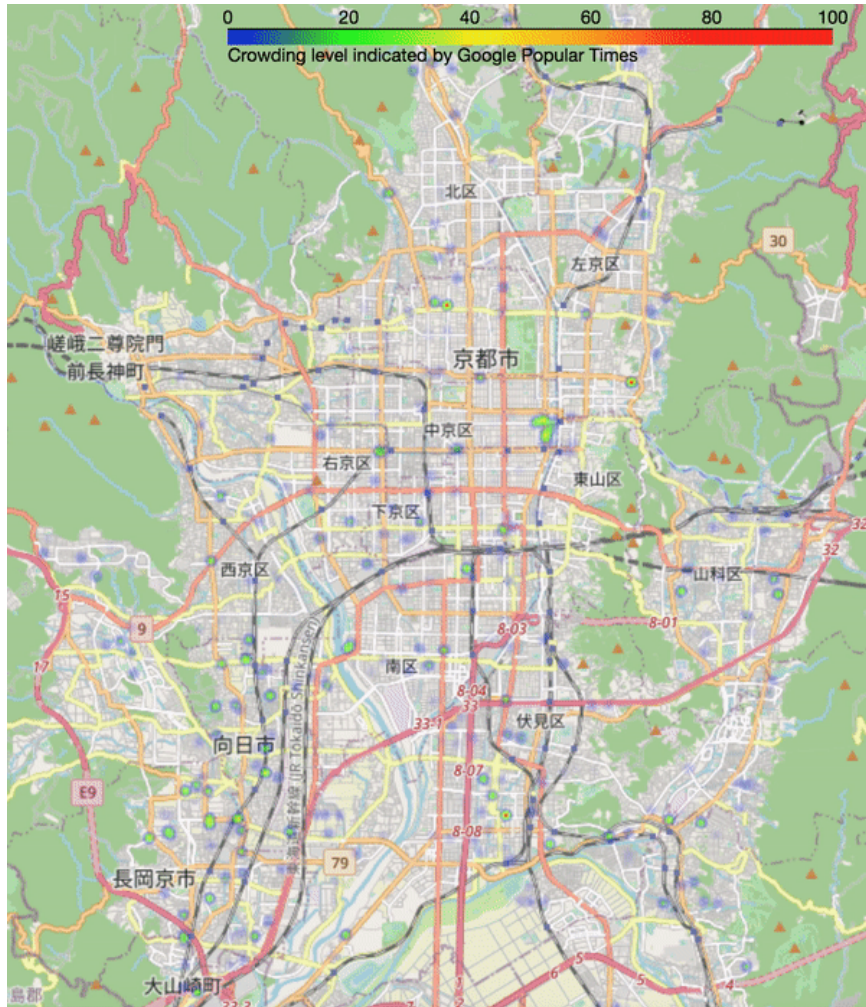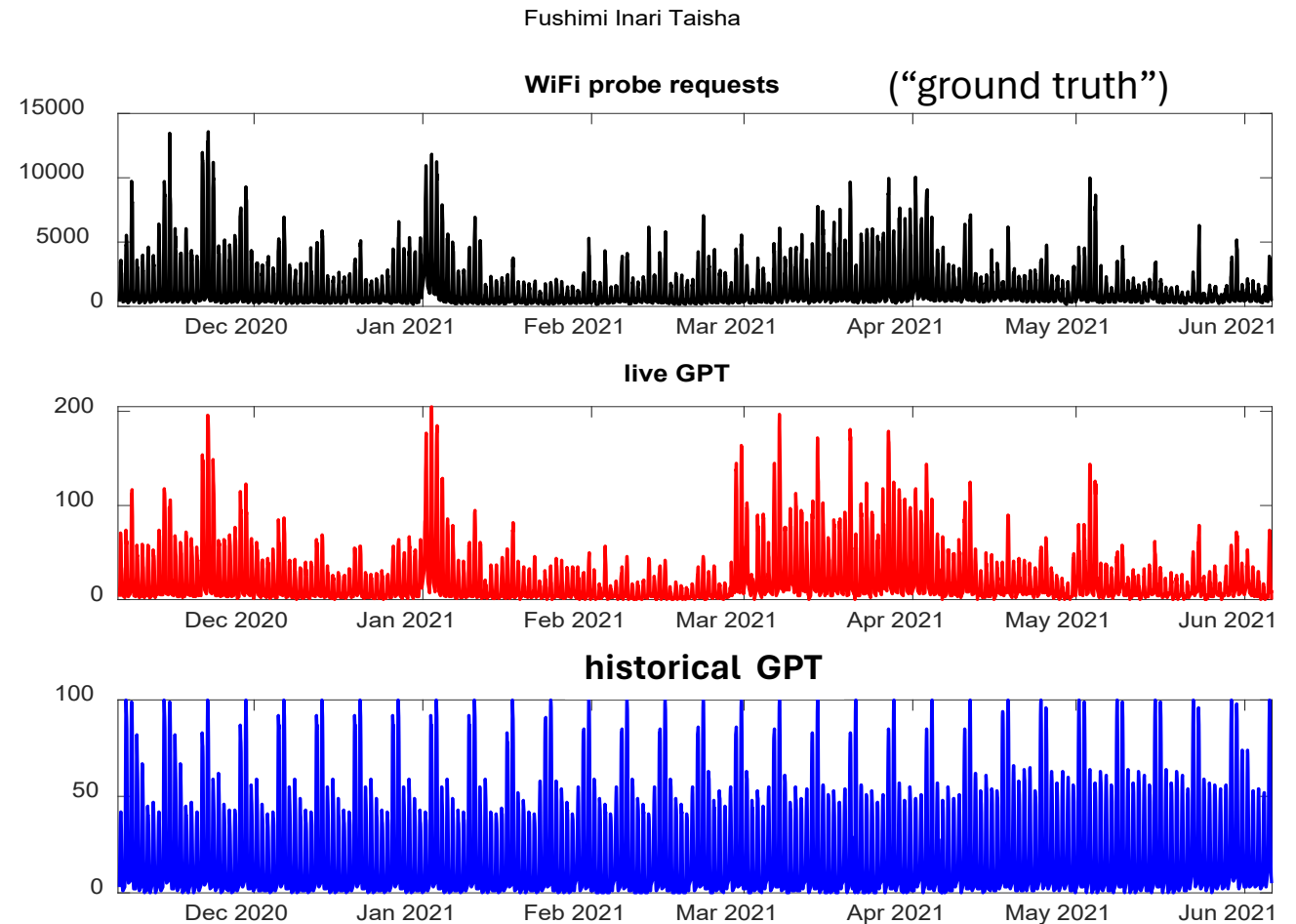Budapest, Hungary

Madrid metropolitan area, Spain

POI with GPT (7,141)
POI with live GPT (869)

POI with GPT (31,876)
POI with live GPT (3,215)

Vongvanich et al. (2023)

Illustration and validation of GPT (Kyoto)

Within-day dynamics

Crowding level indicated by Google Popular Times

Time series trends and data validation (R^2=0.82)

Fushimi Inari Taisha

WiFi probe requests ("ground truth")

live GPT

**historical GPT**

Vongvanich et al. (2023)

Activity split and temporal distribution from geo-tagged social data

The parent POI categories of Foursquare are used as the activity categories

- Arts and Entertainment
- Community and Government (including temple and shrine, which are also landmarks and outdoors)
- Dining and Drinking
- Landmarks and Outdoors
- Retail
- Travel and Transportation

Bi et al. (2023)
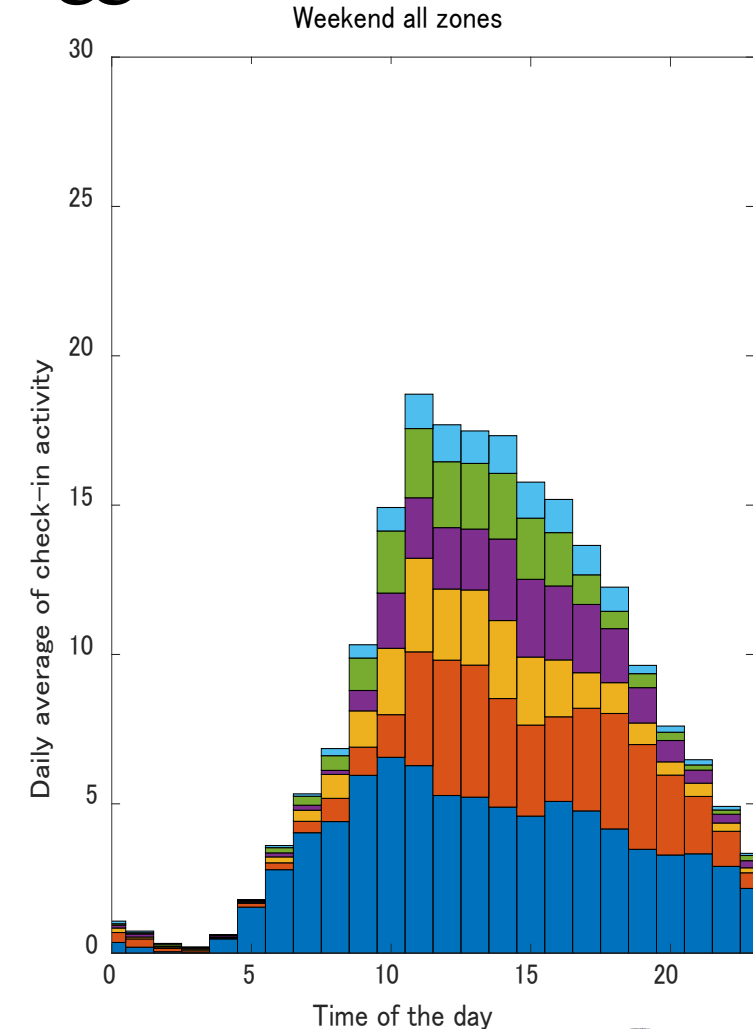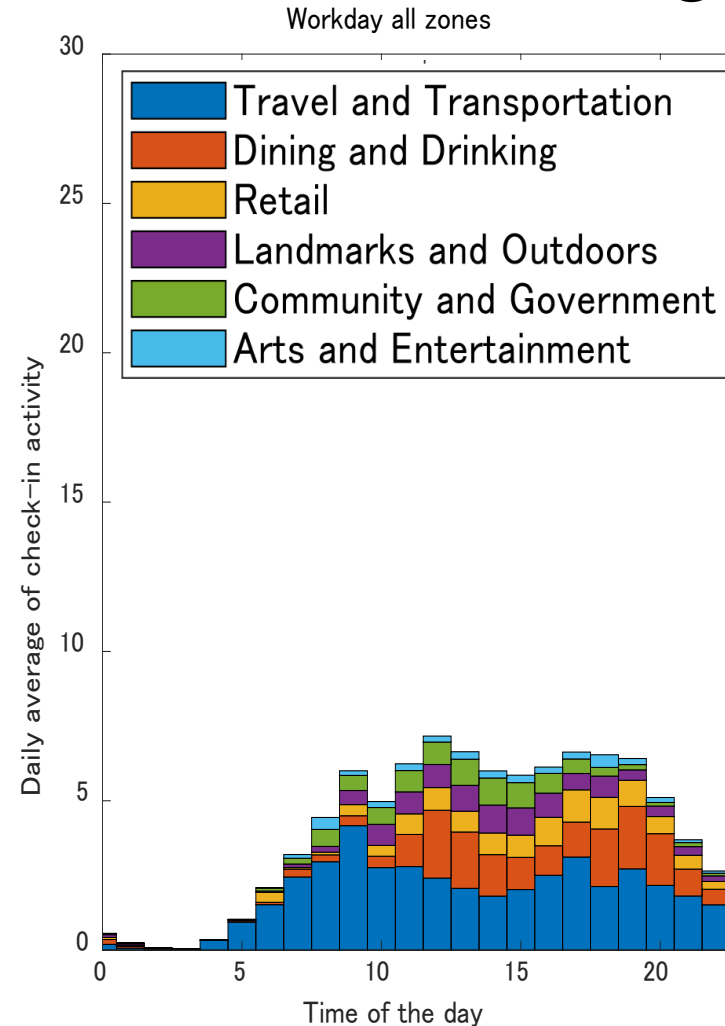
City mood from aggregated tweet sentiments

- Collected Tweets with keywords "Kyoto" or "COVID" during COVID period

- Text mining of moods associated with Tweets

- Time series analysis of sentiments: Correlation to two weeks ahead visits to Kyoto

- Tweet sentiment as one travel demand forecasting indicator
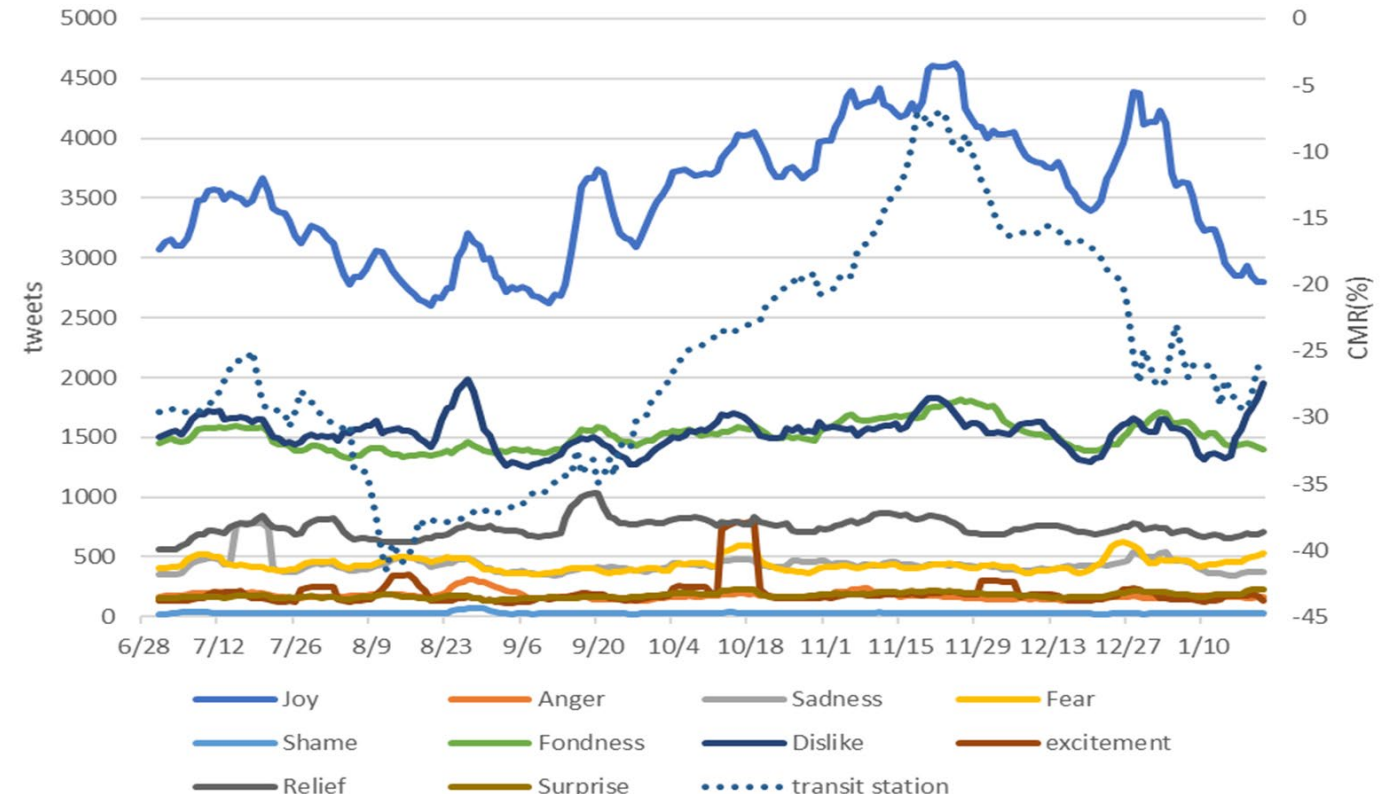
Sun et al. (2023)

CMR: Google Community Mobility Report (% change from pre-Covid data)

Artificial intelligence techniques

- Data sparsity and insufficiency
    - Tensor-based data imputation (Lyu et al., 2024)
    - Data fusion (Mahajan et al., 2021b)
- Pattern recognition
    - Spatial temporal clustering (Santiago-Iglesias et al., 2023)
- Transfer learning + neural networks
    - Resilience pattern prediction (Yang et al., 2024)
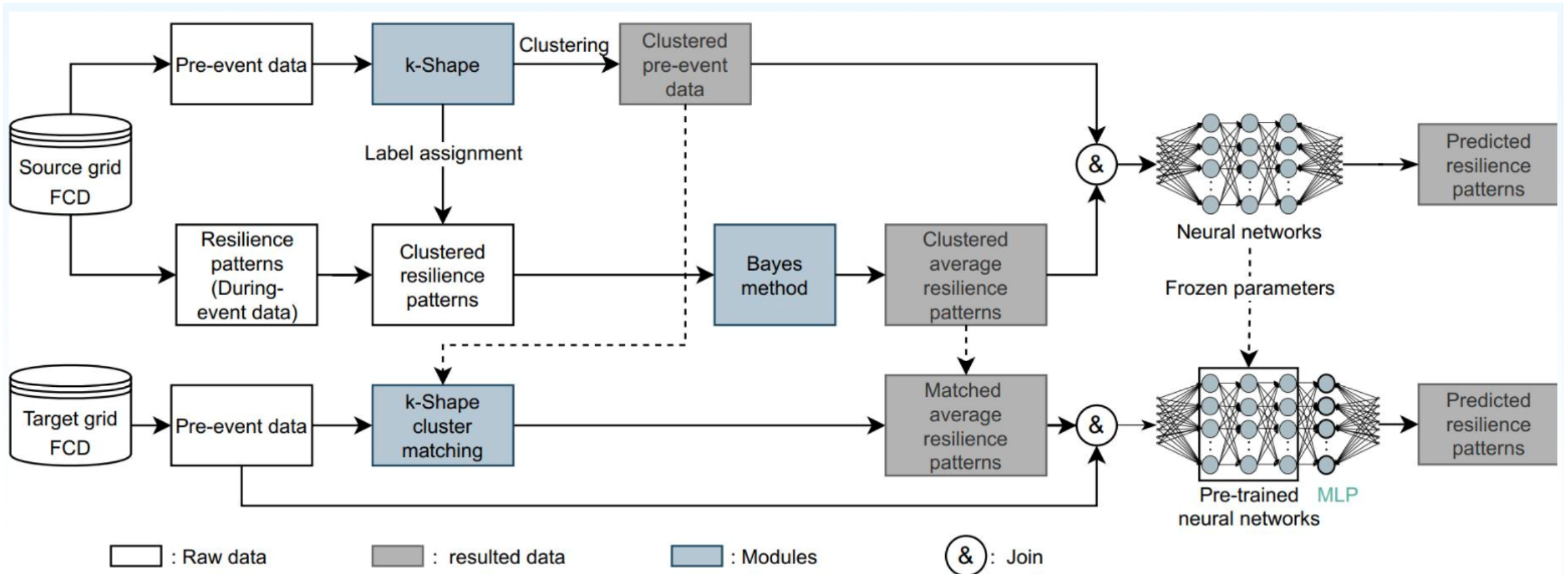
An application of transfer learning

Figure The framework of the transfer learning model

Yang et al. (2024)

Take aways

- A comprehensive resilience modeling framework

- Opportunistic data have limitations, but also potential
    - Capturing changes in activities (incl. in real-time)
        - Impact of Covid (Mahajan et al., 2021a)
        - Filomena storm (Madrid, Santiago-Iglesias et al., 2023)
        - Impact of 9 Euro ticket (Lu et al., 2024a)
    - Capturing "city-mood"

- Capturing the response of the public is essential

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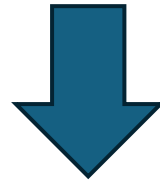
Evidence-based policy

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