Getting to services: Transport & accessibility
OECD and European Commission, 2023

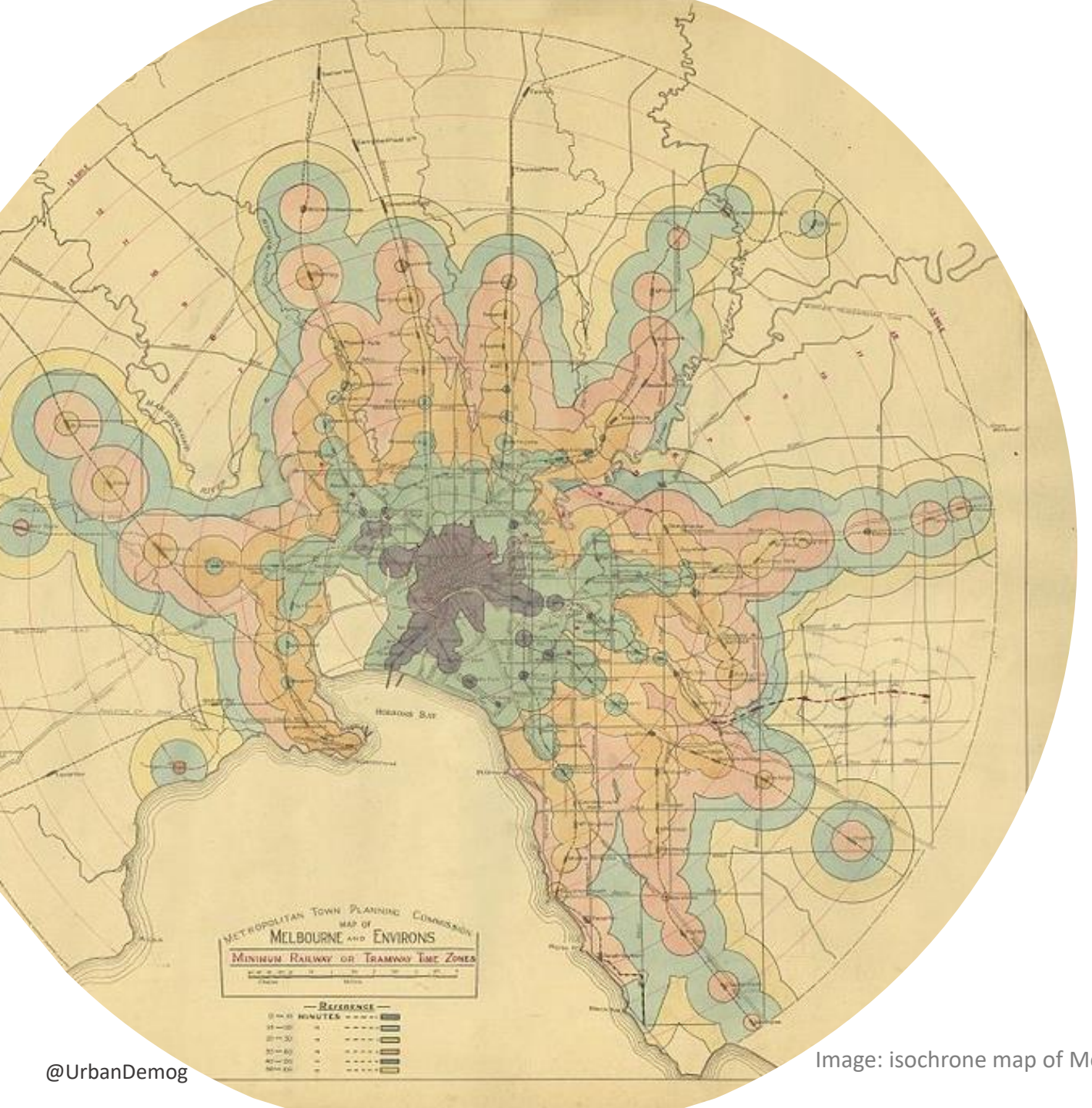
Measuring Access

how far we have come and how far we have yet to go

Rafael H. M. Pereira

@UrbanDemog

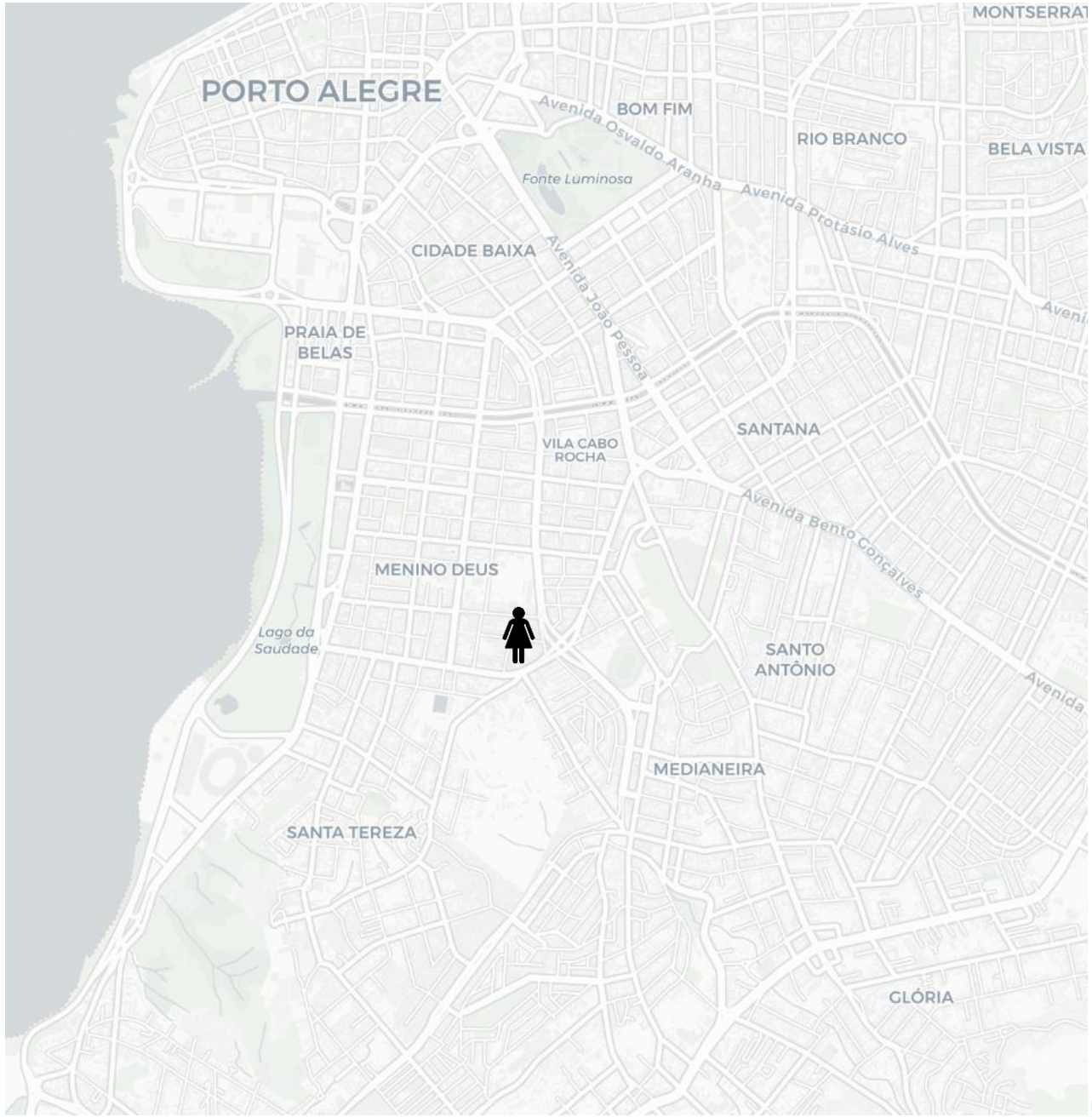
ipea Instituto de Pesquisa Econômica Aplicada



What is accessibility?

Image: isochrone map of Melbourne by rail, 1910-1922

Here is a person



In a city full of possible options

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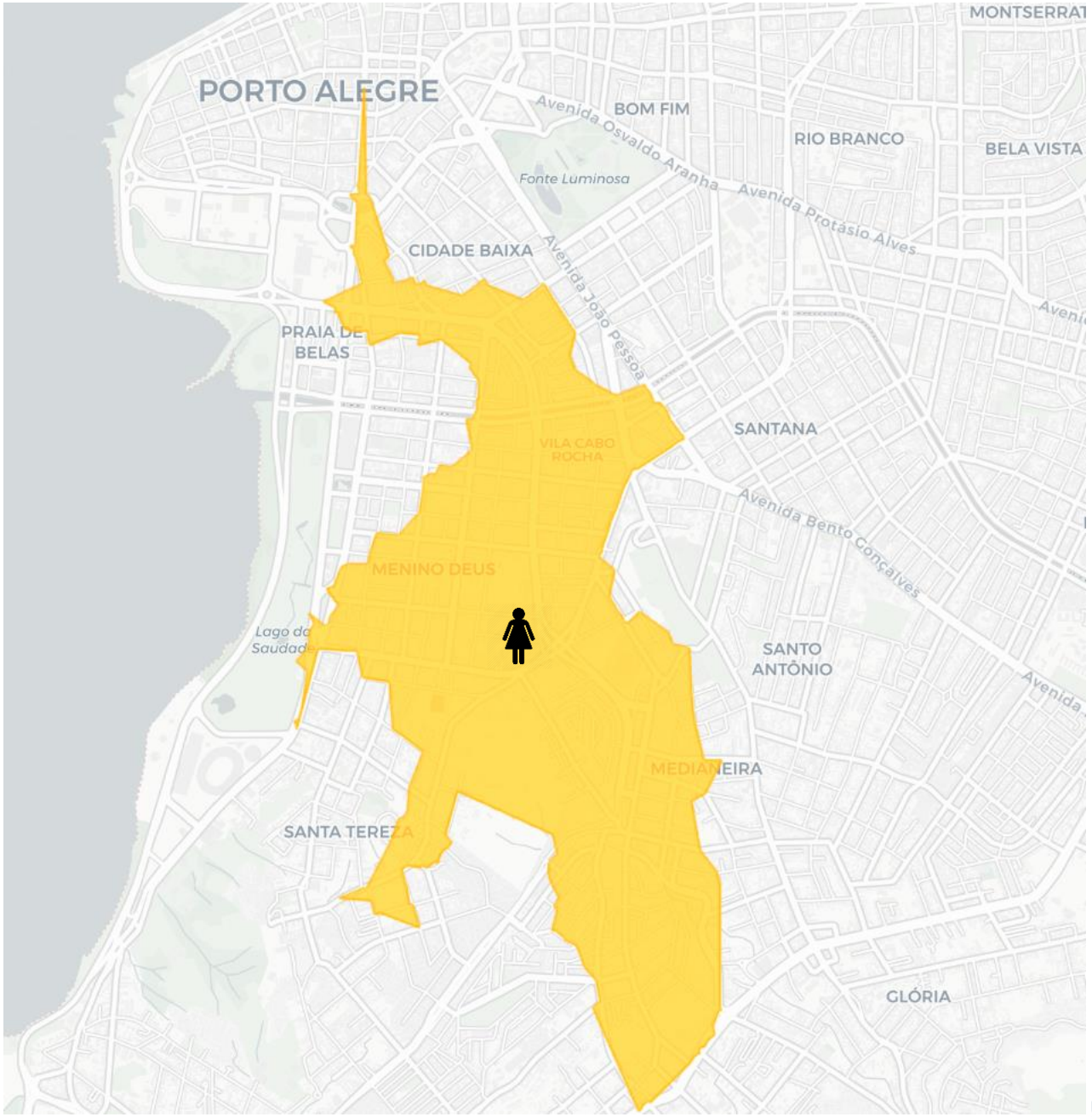
In **30 minutes**

she can get anywhere in the highlighted area



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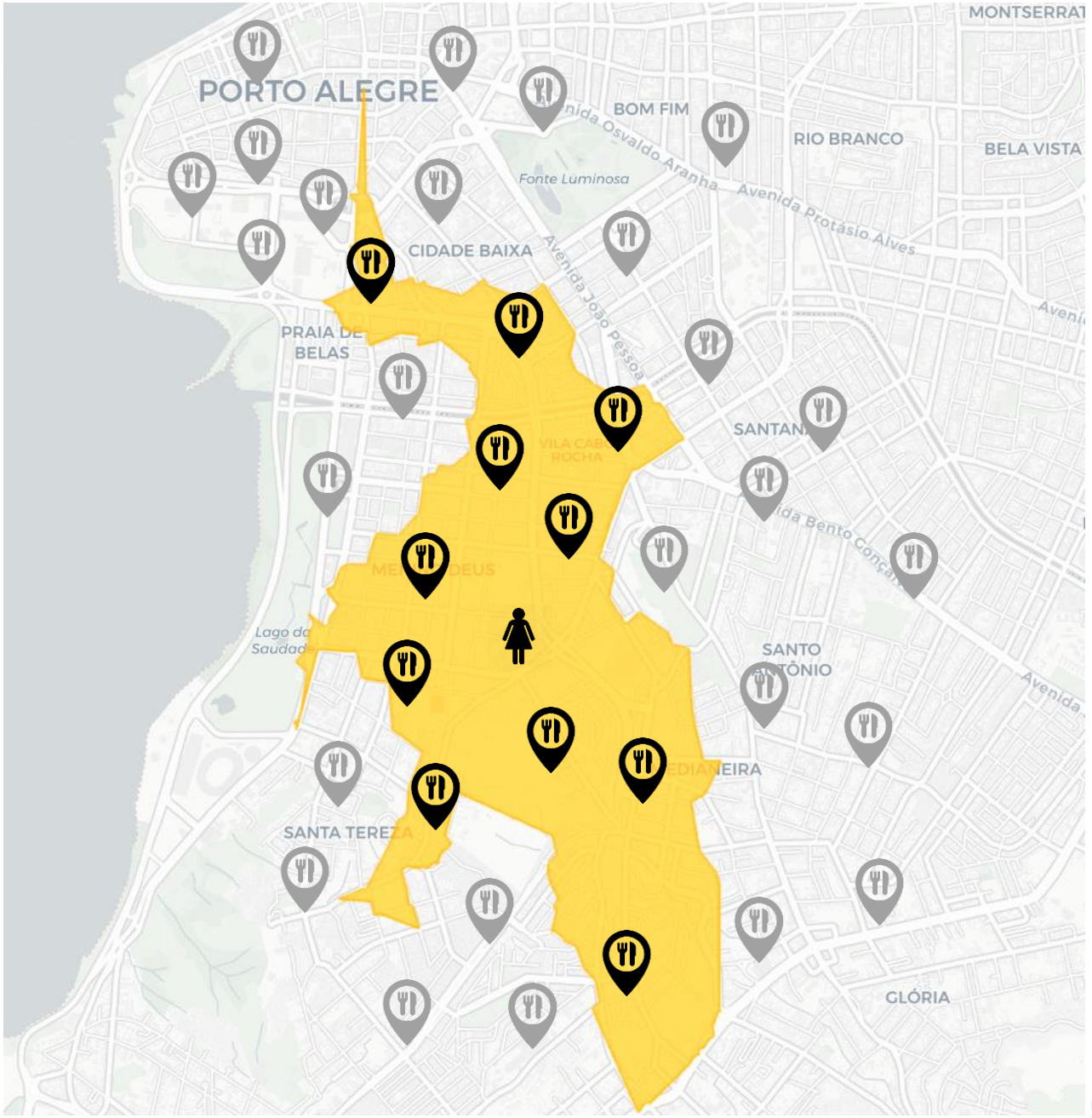
Her **accessibility** level reflects how easy it is for her to get to those activities

Measure:

- Quantity
- Variety
- Quality

- Discounted by
  - travel cost
  - competition



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Why does accessibility matter?

the role of transport access in an inclusive society

Sufficientarian:

It is essential for the satisfaction of **basic needs**

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Why does accessibility matter?

the role of transport access in an inclusive society

Sufficientarian:

It is essential for the satisfaction of **basic needs**

Egalitarian:

It reveals the spatial dimension of **inequality of opportunities**

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Why does accessibility matter?

the role of transport access in an inclusive society

Sufficientarian:

It is essential for the satisfaction of **basic needs**

Egalitarian:

It reveals the spatial dimension of **inequality of opportunities**

Human development:

It provides the **freedom** necessary to **participate in activities and develop other human capabilities**

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How far we have come

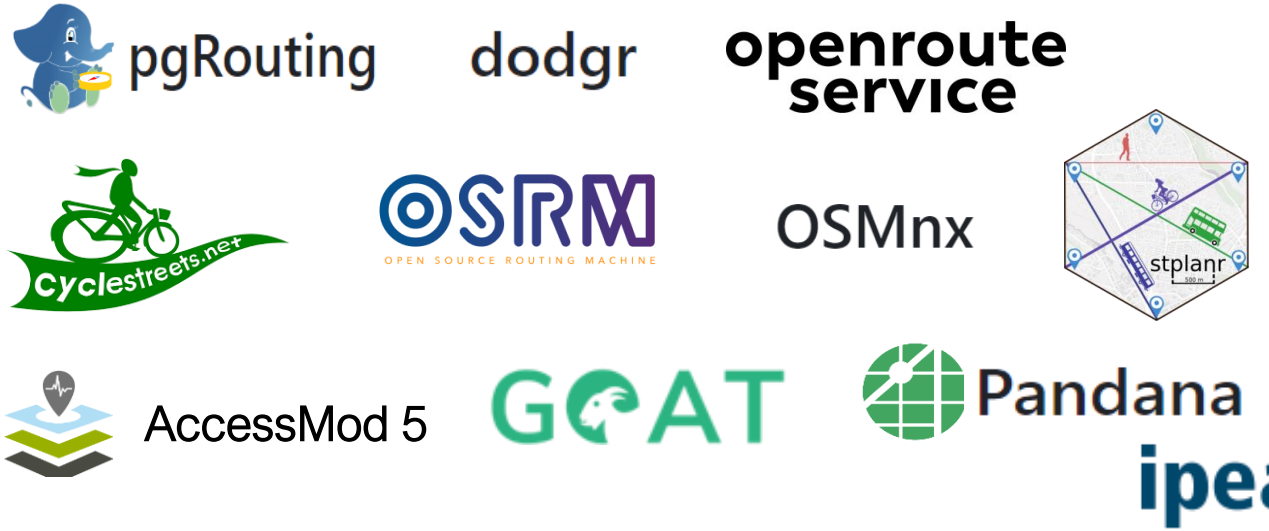
Measuring Access

How far we have come

Measuring Access

Tools – Open source

- Tools for routing / accessibility



How far we have come

Measuring Access

Open Data - globally available

How far we have come

Measuring Access

Open Data - globally available

- Gridded population estimates

  - 1Km: GPW4 / Sedac

  - 100m - 1Km: WorldPop

  - 100m and 1Km GHSL / European commission

  - 30m: Meta Data for Good

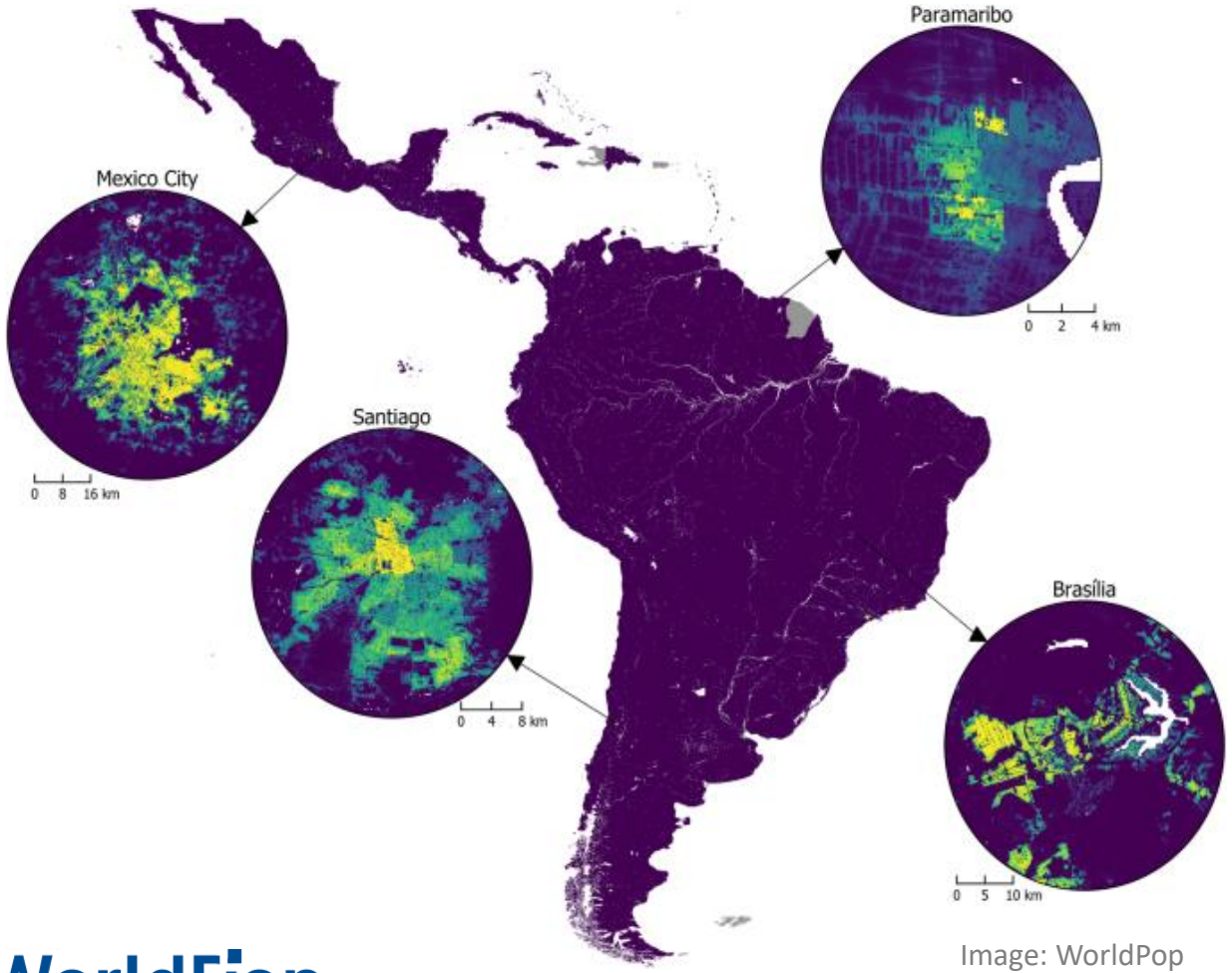


Image: WorldPop

How far we have come

Measuring Access

Open Data - globally available

- Gridded population estimates
- Topography

30m: Shuttle Radar Topography Mission

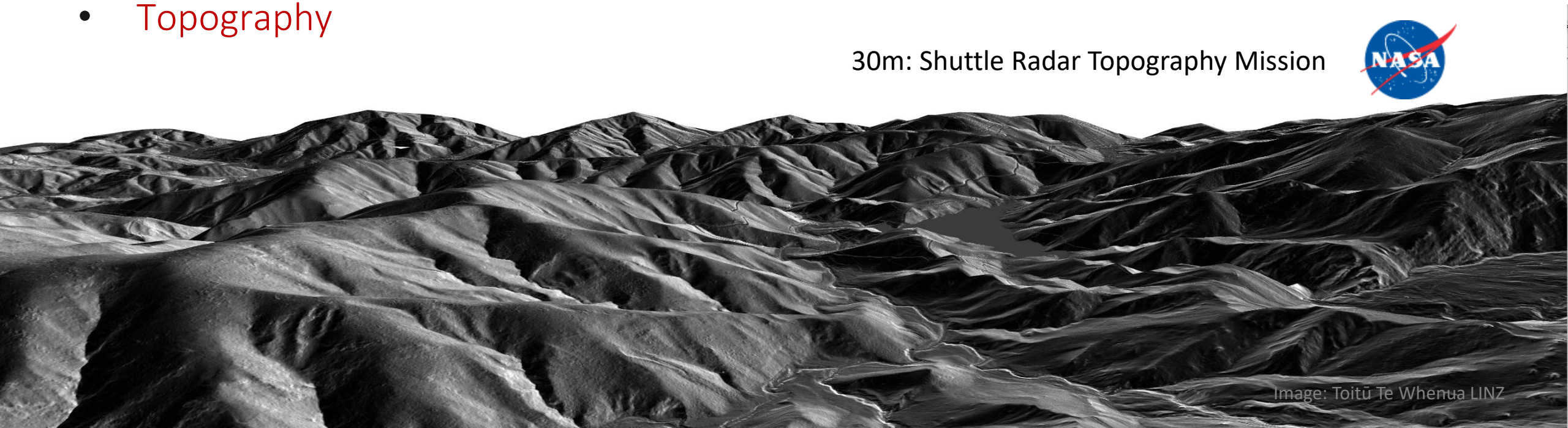


Image: Toitū Te Whenua LINZ

How far we have come

Measuring Access

Open Data - globally available

- Gridded population estimates
- Topography
- Road networks

Image: GFDRR OpenStreetMap Africa & DALL-E

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How far we have come

Measuring Access

Open Data - globally available

- Gridded population estimates
- Topography
- Road networks
- Accessibility estimates (large-scale national projects)

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How far we have yet to go

Measuring Access

- Spatial distribution of jobs and facilities
  - Quality of services
  - Working hours
  - Capacity

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How far we have yet to go

Measuring Access

- Spatial distribution of jobs and facilities
  - Quality of services
  - Working hours
  - Capacity

- Personal characteristics
  accounting for gender, age, disabilities etc

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How far we have yet to go

Measuring Access

- Spatial distribution of jobs and facilities
  - Quality of services
  - Working hours
  - Capacity
- Personal characteristics
  accounting for gender, age, disabilities etc
- Public transport data
  - GTFS (good quality)
  - GPS
  - Informal transit

- Looking beyond travel time
  - Monetary costs
  - Environmental emissions

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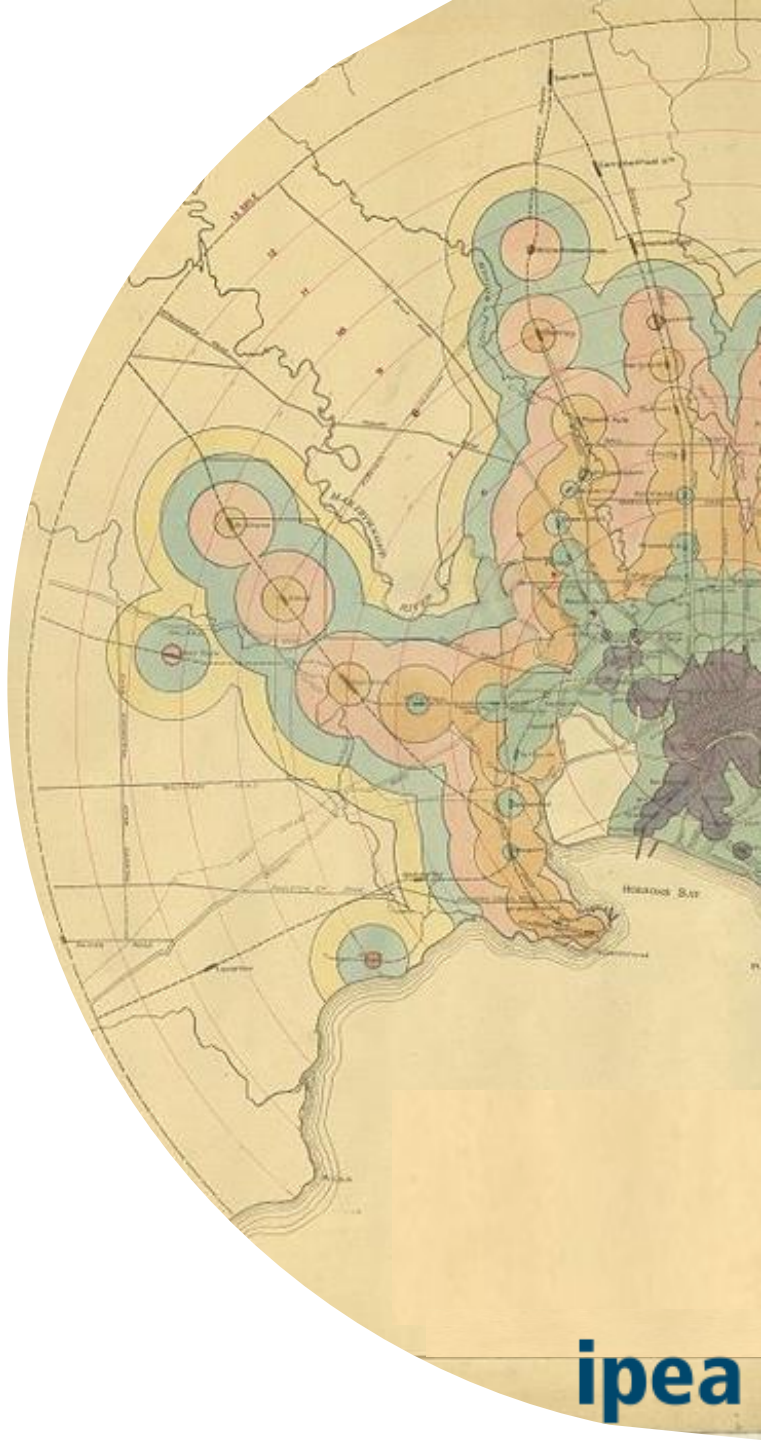
Persistent challenges

Measuring Access

- Expand the adoption of **open data** practices
- International coordination of **data standards** (and quality)

Developing access-oriented policies

- Data science skills and **training**
- Defining accessibility poverty (**political debate**)



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Spatial Access Measures

Measuring access to services and amenities using active and public modes of transportation in Canada

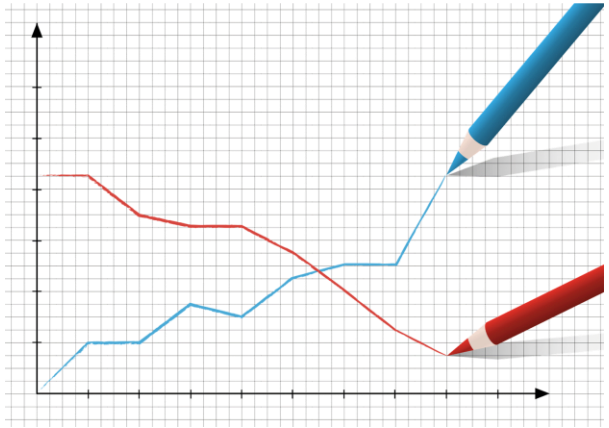
Prepared for the OECD Webinar Getting to services: Transport & accessibility – October 26, 2023

By the Centre for Special Business Projects
Statistics Canada

Delivering insight through data for a better Canada

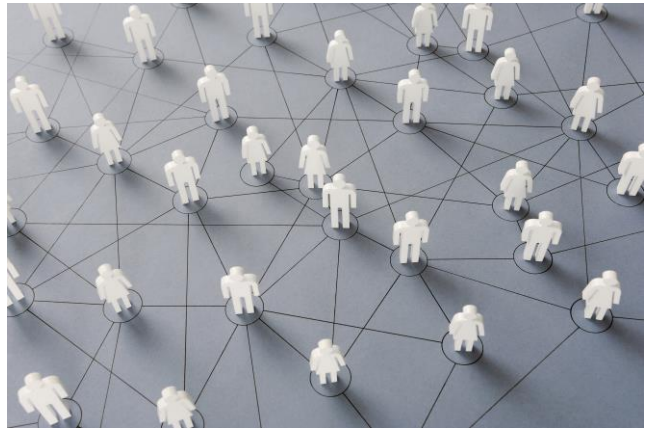
Addressing a data gap and a pressing policy need

Until recently, Canada did not have geographically granular measures of spatial access/proximity



Location is an important element of economic and social outcomes

Physical proximity is a determinant of accessibility



Spatial accessibility is a key dimension of social inclusion, thus of social and economic outcomes

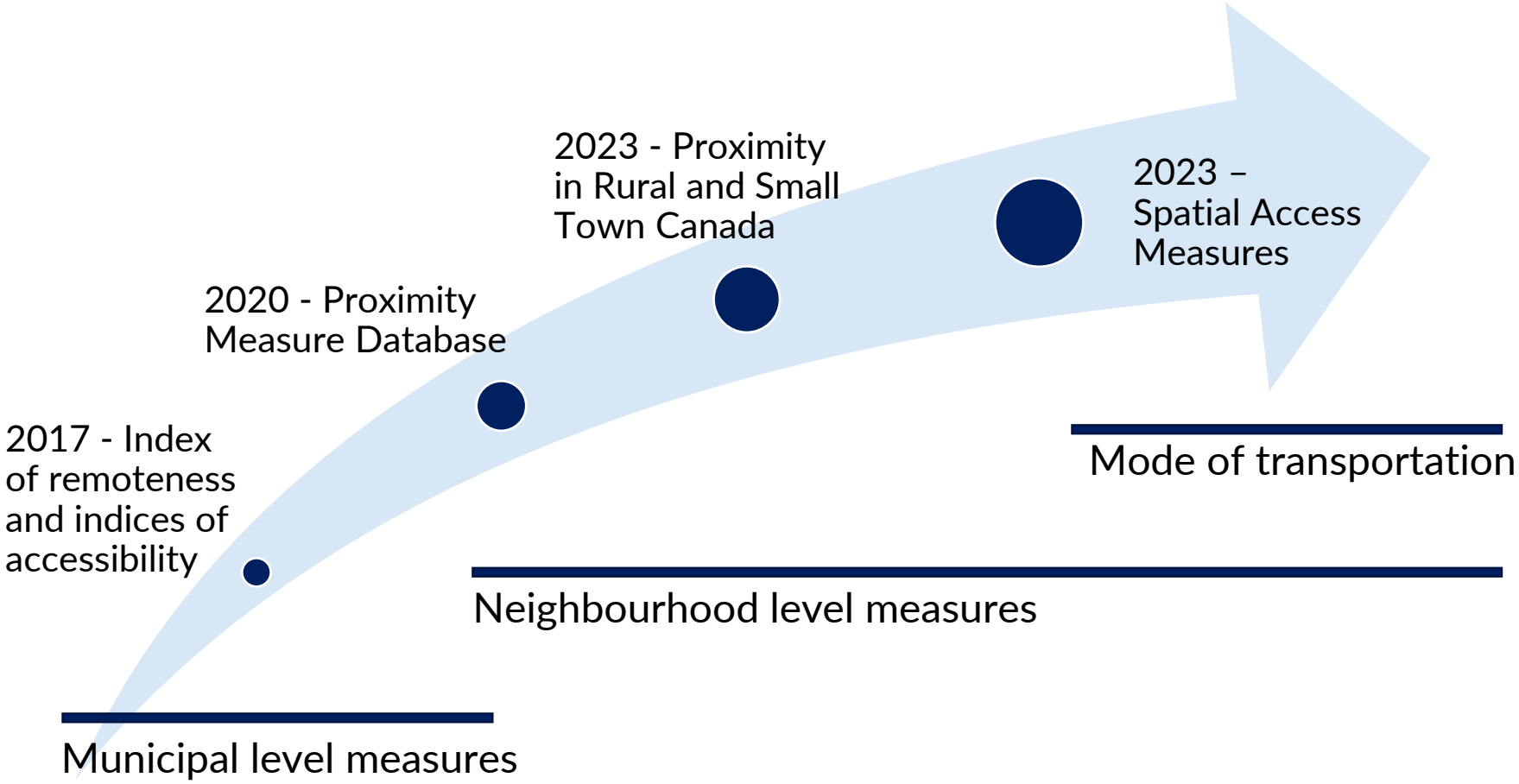
Data and computational tools are becoming increasingly abundant and open-source

Computational capacity

Open-source tools

Continuous improvements in geo-coding official statistics and open data

The journey toward increasingly granular and more refined spatial access measures



Spatial Access Measures (SAM) using active and public modes of transportation

- A focus on spatial access at the neighborhood (Dissemination Block) level through public transit and active modes of transportation
  - Four modes of transportation: public transit during peak hours, public transit during off-peak hours, cycling, and walking
  - Seven types of services and amenities: healthcare, primary education, post-secondary education, grocery stores, sports and recreation facilities, and cultural and art facilities, places of employment
- This combination results in a total of 28 spatial access measures, computed at the block level (area generally bounded by a road on all sides), for all of Canada

How spatial access is defined with different transportation modes

- **Access by public transit during peak hours** represents the degree to which a type of amenity is accessible within a 90-minute trip on the transit network during peak hours of service (7:00 a.m.-9:00 a.m.)
- **Access by public transit during off-peak hours** represents the degree to which a type of amenity is accessible within a 90-minute trip on the transit network during off-peak hours of service (2:00 p.m.-4:00 p.m.)
- **Access by cycling** represents the degree to which a type of amenity is accessible within a 30-minute bike ride
- **Access by walking** represents the degree to which a type of amenity is accessible within a 30-minute walk

SAM data sources

- **A major data integration effort.** Using a combination of Statistics Canada's data holdings and open data:
  - Business Register (StatCan) for the location and size of amenities and services
  - Linkable Open Data Environment (StatCan integration of open data) for the location of amenities and services
  - General Transit Feed Specifications (GTFS) data for public transit
  - OpenStreetMap (OSM) road network data
- **At the highest possible level of geographic granularity**
  - Dissemination block level, in combination with building footprints data
- **Data processing largely based on open-source software and applications**
  - Computation code in R & Python
  - Distance computation and routing engines (R5R for public transit and Valhalla for cycling and walking)

SAM methods highlights

- **Computationally intensive**:
  - The optimal route between an origin and destination point was computed for over 2 billion origin-destination pairs
- **Robust**: schedule variance was accounted for using the R5R time window feature
- **Route optimization based on preferences**:
  - Routes with extreme changes in elevation are avoided by cyclists and walkers
  - Routes with dedicated cycling infrastructure are preferred

A generalized model

A gravity models accounts for the number and/or size of all services accessible within a certain distance radius, with a possible penalty for increasing distance form origin to destination. Largely established in the literature.

Gravity Model

Accounts for mass and distance

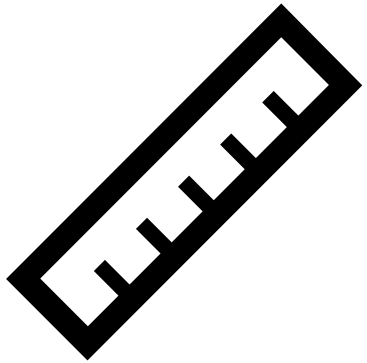
=

Mass

The quantity of the amenity that is available at the location

÷

Distance



Quantifies how far apart the origin and destination points are

SAM model adaptation

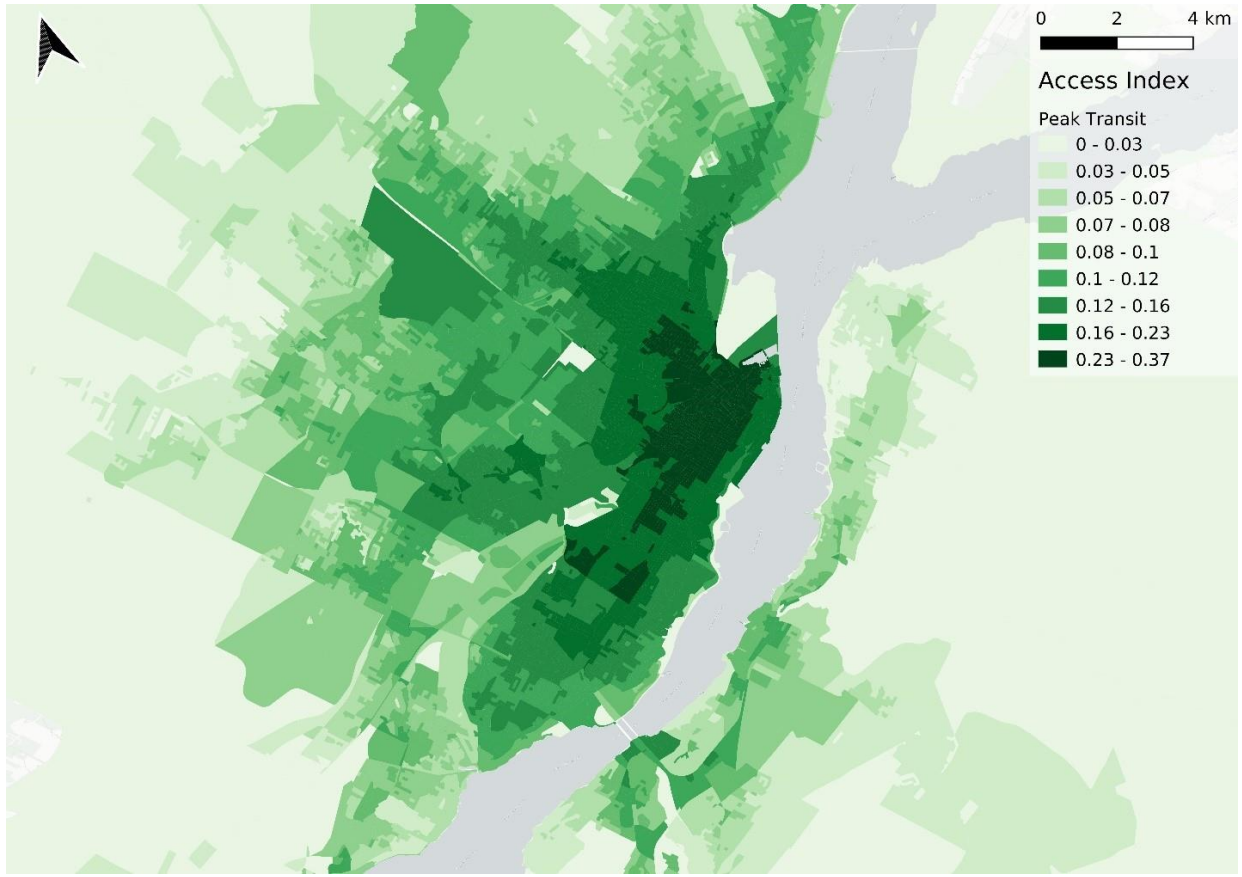
- **Gravity model specification**:
  - The attractiveness of a destination is proportional to the mass of the destination and proportional to the willingness to travel from the origin to the destination
- **Willingness to Travel**:
  - Estimated by transforming the duration with an impedance function
  - The shape and slope of the impedance function was calibrated according to the mode of transportation and destination amenity empirically
  - Statistics Canada Time-Use data from the General Social Survey was used to calibrate the function

SAM results, from national to local

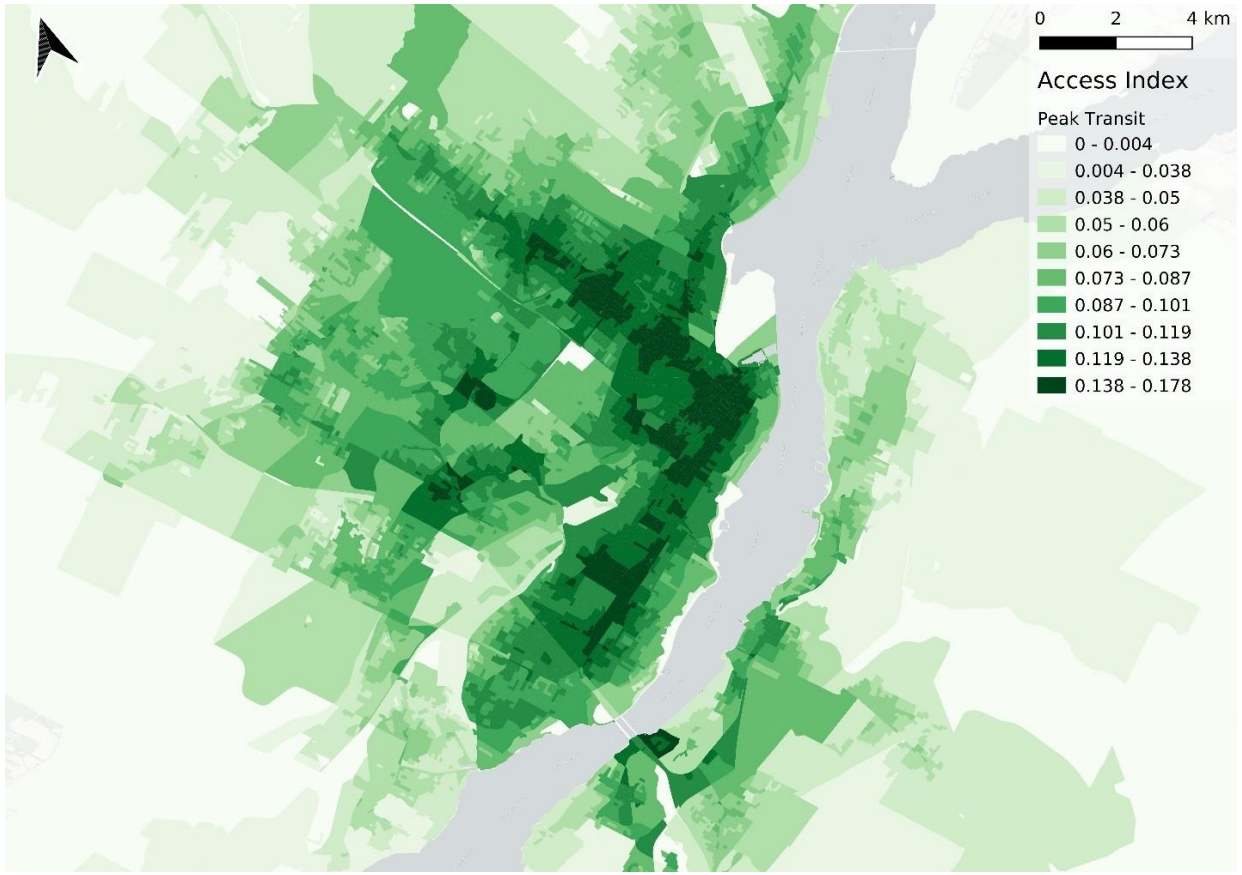
- Twenty-eight indices for approximately half-million dissemination blocks of Canada that allow for analysis at multiple levels of geography, from the national to the local level
- An example:
  - At the national level, about 60% of Canadians have some degree of access to post-secondary education by public transit during peak hours, and about 40% of Canadians have some degree of access to post-secondary education by bike
  - At provincial level, access to post-secondary education by public transit during peak hours ranges from about 65% in western provinces (British Columbia, Alberta) to less than 20% in some of the Atlantic provinces; access to post-secondary education by bike varies from about 30% (in Alberta) to close to 60% on Quebec
  - At the local level, the geographic granularity of the spatial access measures can be mapped and provide detail information on high-access and low-access neighborhoods

An example of results at the local level

Access to post-secondary education, peak transit hours, Québec City



Access to primary education, peak transit hours, Québec City



Source: Statistics Canada, Centre for Special Business Projects & © OpenStreetMap contributors, © CARTO
Note: Symbology is based on deciles for the CSD of Québec City (10-quantiles, or ten continuous intervals with equal amounts of observations). Intervals consisting of only zeroes have been removed from the symbology. The index values are scaled between 0 and 1 where 0 is the minimum value for all of Canada while 1 is the maximum value for all of Canada.
Since the index values are relative to the minimum and maximum values nationwide, most values appear quite close to 0.

What is next? More analysis and policy modeling

- **Ongoing work**, mainly in policy departments. By combining SAM or PMD with the geolocation of different demographic groups, the analytical opportunities are vast
- With publicly available spatial access measures, **independent researchers and digital journalists** can use these resources for analysis, impactful visualizations, and contributions to the policy debate. Examples (with PMD):
- The 15-minute city aims to build more liveable neighbourhoods. In Canada, only 23 per cent of urban dwellers live in this type of area, The Globe and Mail article in the Future of Cities series:
  - "Amenity-rich neighbourhoods are scarce in most of Canada's cities; only 23.2 per cent of urban dwellers live in these types of areas. This suggests that creating a country of 15-minute cities will be challenging: it would likely mean bringing even more people into central Vancouver and Toronto and parts of Montreal, and making changes to the suburbs."
- We used AI to measure Canada's urban sprawl, CBC/Radio-Canada visualization and analysis
  - "On average, the urbanized area of the top nine metropolitan areas expanded by 34 per cent, while their total population increased by 26 per cent (15.7 million in 2001 compared to 20 million in 2021). This gap caused a 6 per cent density loss (3,152 people per sq km in 2001 compared to 2,975 in 2021)."
  - "89 per cent of newly urbanized land in the top nine metropolitan areas comprises neighbourhoods with a low density in services and amenities. In comparison, 73 per cent of historical urban land is low-density."

What is next? Different policy focus, hence different measures

- **A diversity of policy needs.** Each agency, level of government, country may have a different policy focus and needs. For example, proximity/spatial accessibility measures can be used to:
  - Identify under-served communities or neighborhoods and improve access to services in these areas; or improve access to specific services for minority groups (e.g., linguistic minorities, Indigenous population, people living in remote communities).
  - Develop quality of life metrics and analyze the relationship between spatial access to services and social or economic outcomes (health outcomes, education attainment outcomes, etc.)
  - Support infrastructure investment decisions and long-term planning of service delivery, to improve geographic distribution and/or efficiency in service delivery
- In Canada, most of the development of proximity and spatial access measures was driven by **housing policies**. A growing population and demographic shifts are leading to increasing demand for housing; investments to increase housing supply should consider access to services (including for remote communities, Indigenous population, minority groups, etc.)
- **For spatial access measures… the sky is the limit.** For example, we are now working on measures of proximity to veterinary services, and modelling spatial access to care for rare diseases

Resources and contacts

Statistics Canada releases

- Spatial Access Measures - database
- Proximity Measures Database - database
- Proximity Measures Data Viewer - visualization
- Measuring proximity to services and amenities - working paper
- Proximity to services and amenities in Rural and Small Town Canada (ProximityRST) - visualization
- The Linkable Open Data Environment – databases

More information, questions? Contact us

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Funded by the European Union

Transport and Access to Services in Settlements of OECD Regions

OECD/EC workshop
Getting to services: Transport & accessibility
26 Oct 2023

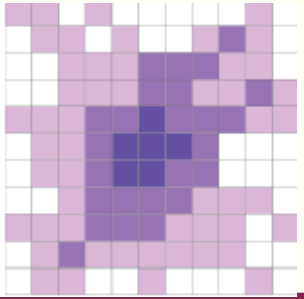
Alison Weingarden
Centre for Entrepreneurship, Regions and Cities (CFE)

Accessibility within & across OECD countries

Focus on settlements (cities, towns and villages):

- Service provision
- Accessibility beyond settlement borders
- Role of public transport

→ Use population grids, service locations & travel time data



Settlement network project workstreams

Workstream 1:
Provision of services in many countries

- Results depend on settlement size and access to cities

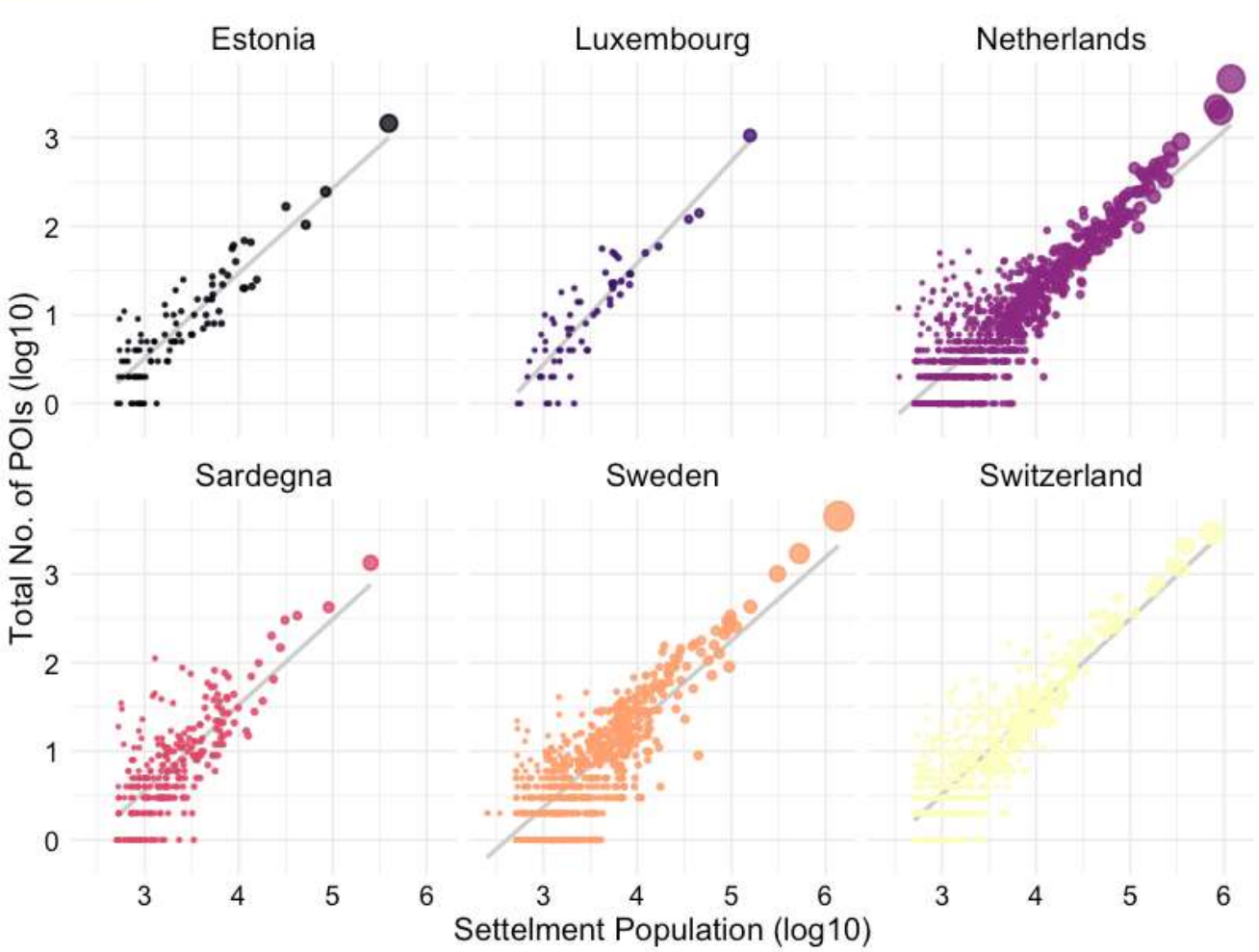
Workstream 2:
Population change and urbanisation

Workstream 3 (in progress):
Travel time and transport modes

- Interaction with services

Larger settlements have

- More service variety
- More “Point of Interest” (POI) locations



Service workstream methods & results

Regressions for number of service locations (e.g. schools, pharmacies) or, for less prevalent services, whether there is any location (e.g. hospitals, universities)

Finding 1: Regional centres (largest settlement within 30 mins) have more services than non-regional centres.

Finding 2: Towns and villages far from cities tend to have more services than similar-size settlements close to cities.

Transport workstream

Getting to settlements…

- Total population that can reach any part of the settlement within certain travel time (e.g., 30 mins, 1 hour)
  - Private (car) vs. public (multi-modal)

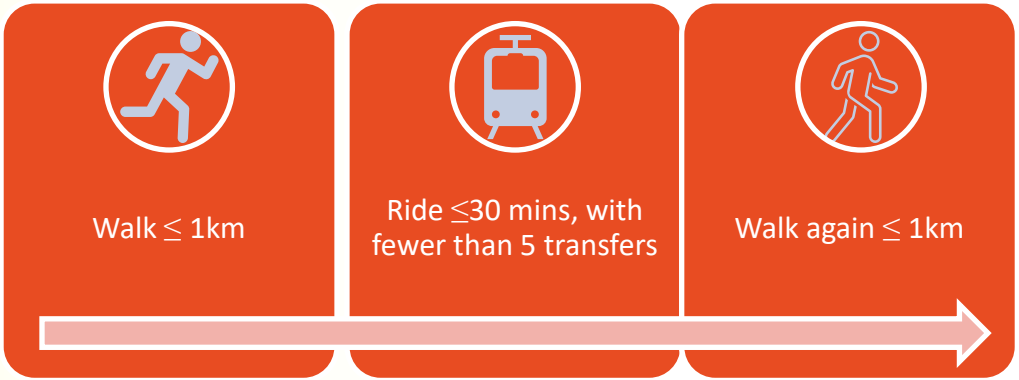
…and services

- Do settlements with good public transport connections have more services?

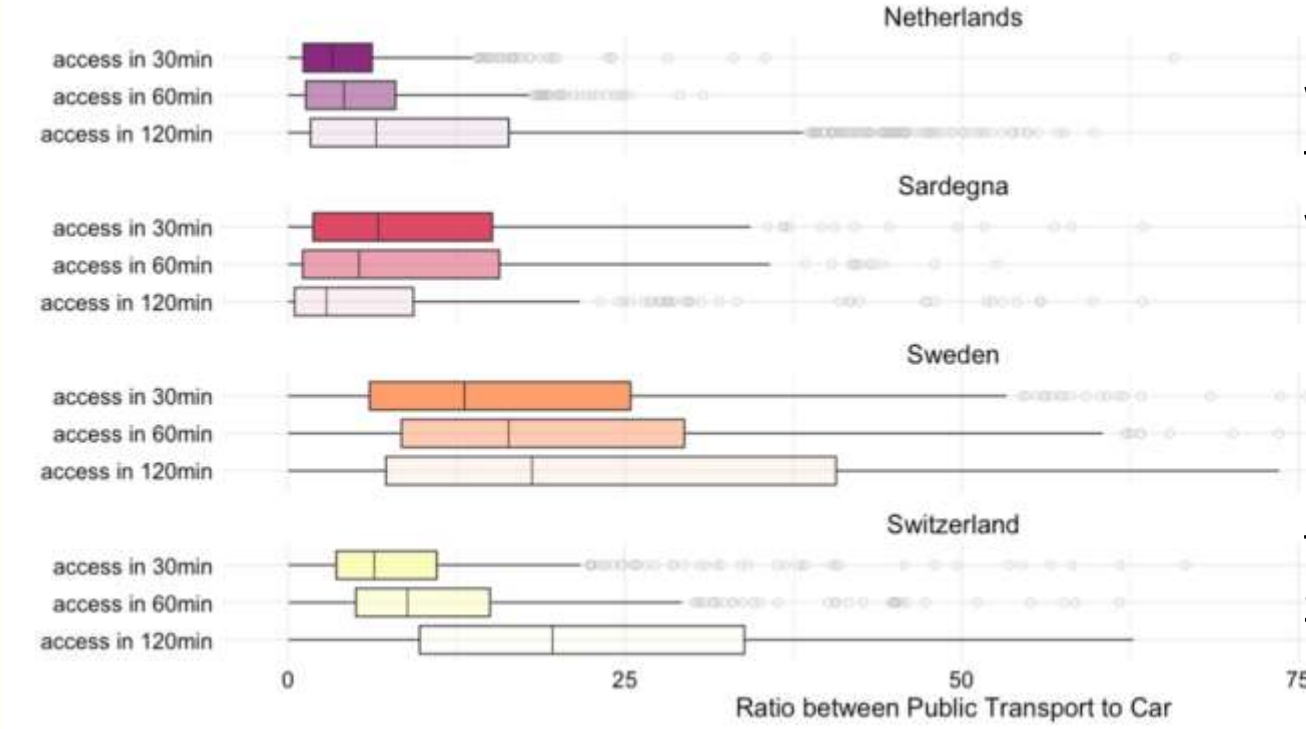
Multimodal transport

Country coverage: 5 countries + 2 regions with good GTFS data

- Estonia, Luxembourg, Netherlands, Sweden, Switzerland
- Quebec (Canada), Sardinia (Italy)

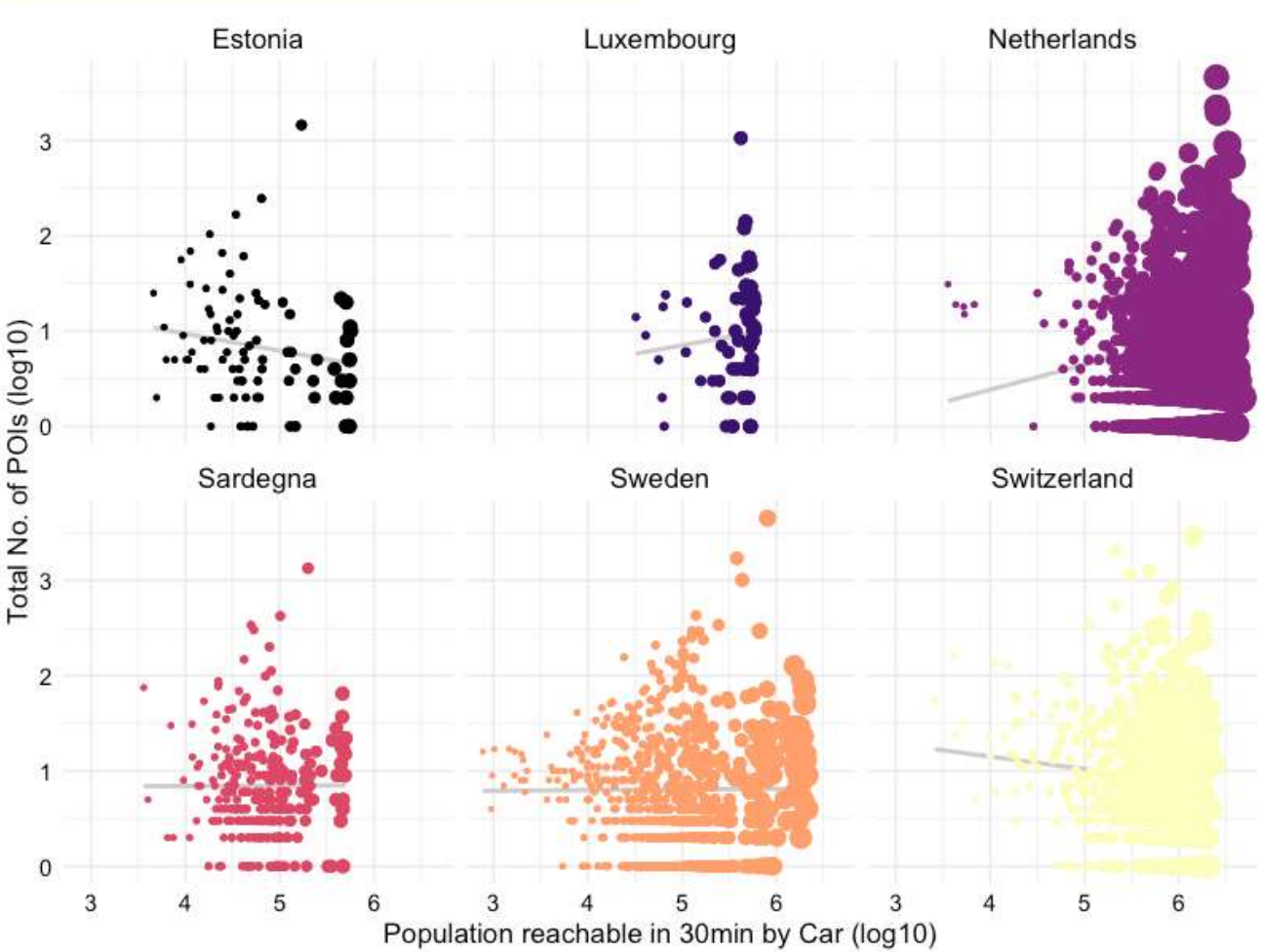


Results: Population with access through public transport



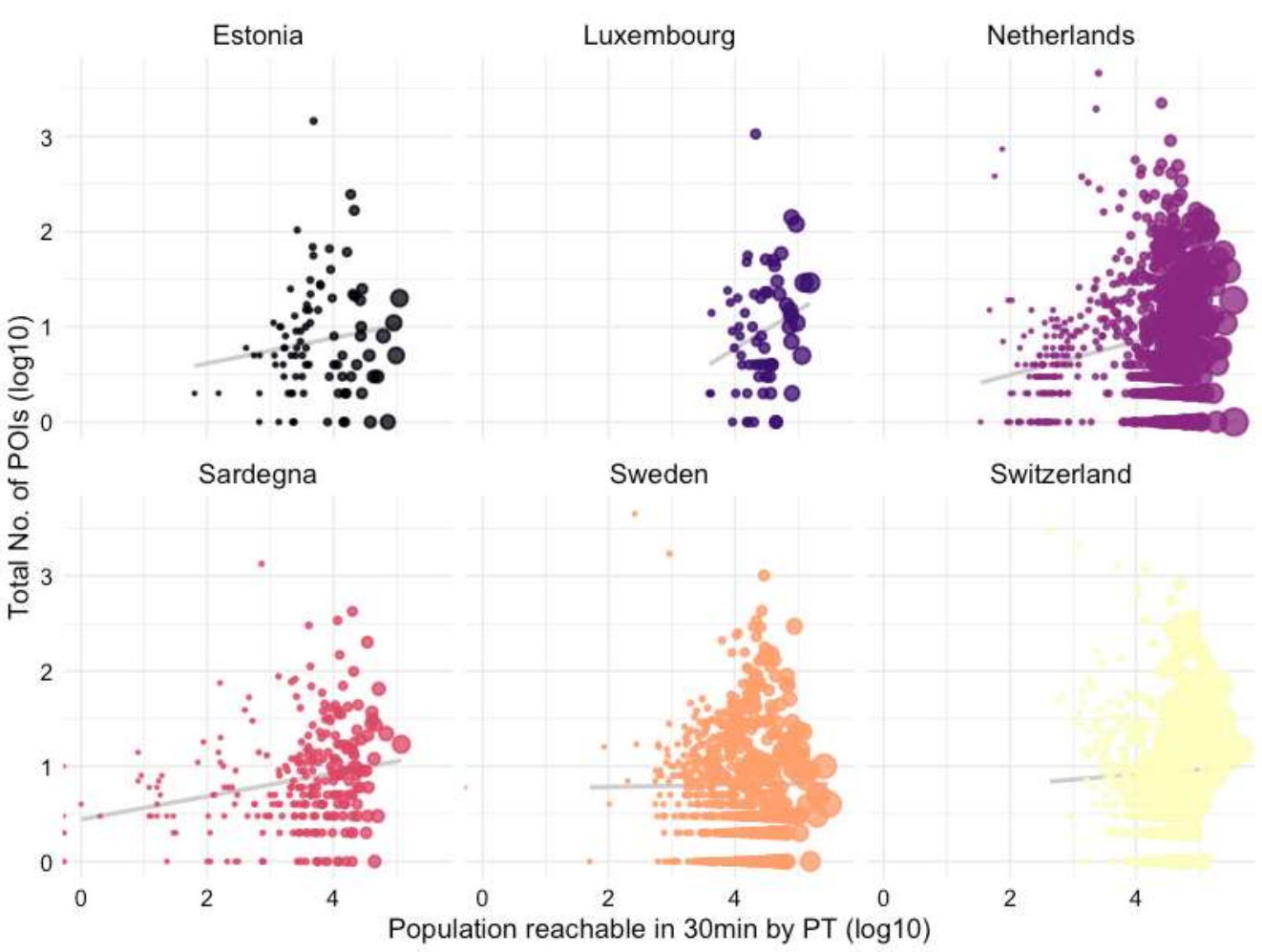
Ratio of population with public transport to those with car access within 30 mins is **mostly below 10%**

Higher time thresholds make ratio better in four places; worse in Sardinia & Estonia



Total services vs. population with **car** access (30 min threshold)

Ambiguous patterns (-, 0, +)



Total services vs. population with **public transit** access (30 min threshold)

Weak positive relationships

Next steps

Connecting the dots

- Do services cluster in places with good public transport?
- Transport performance ratios

Regression framework:

- Relationship between service provision and public transit access, controlling for population inside settlement

Geospatial Lab: https://oe.cd/GeospatialLab

Project website:

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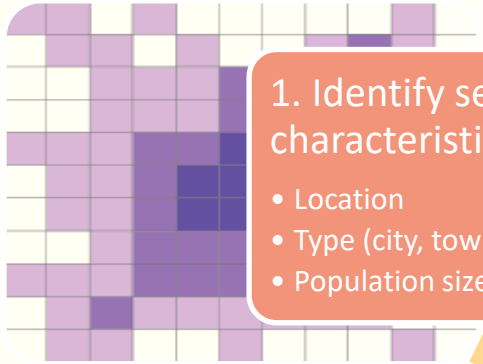
Twitter: @OECD_local
LinkedIn: www.linkedin.com/company/oecd-local
Website: www.oecd.org/cfe

OECD

Service provision relates to settlement size & proximity

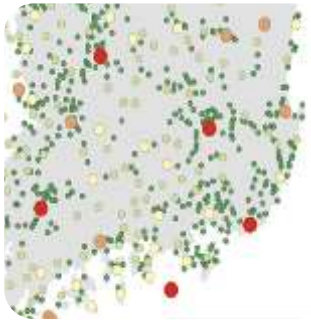


1. Identify settlement characteristics

- Location
- Type (city, town, village)
- Population size

2. Proximity of each settlement to others

- Position in urban hierarchy



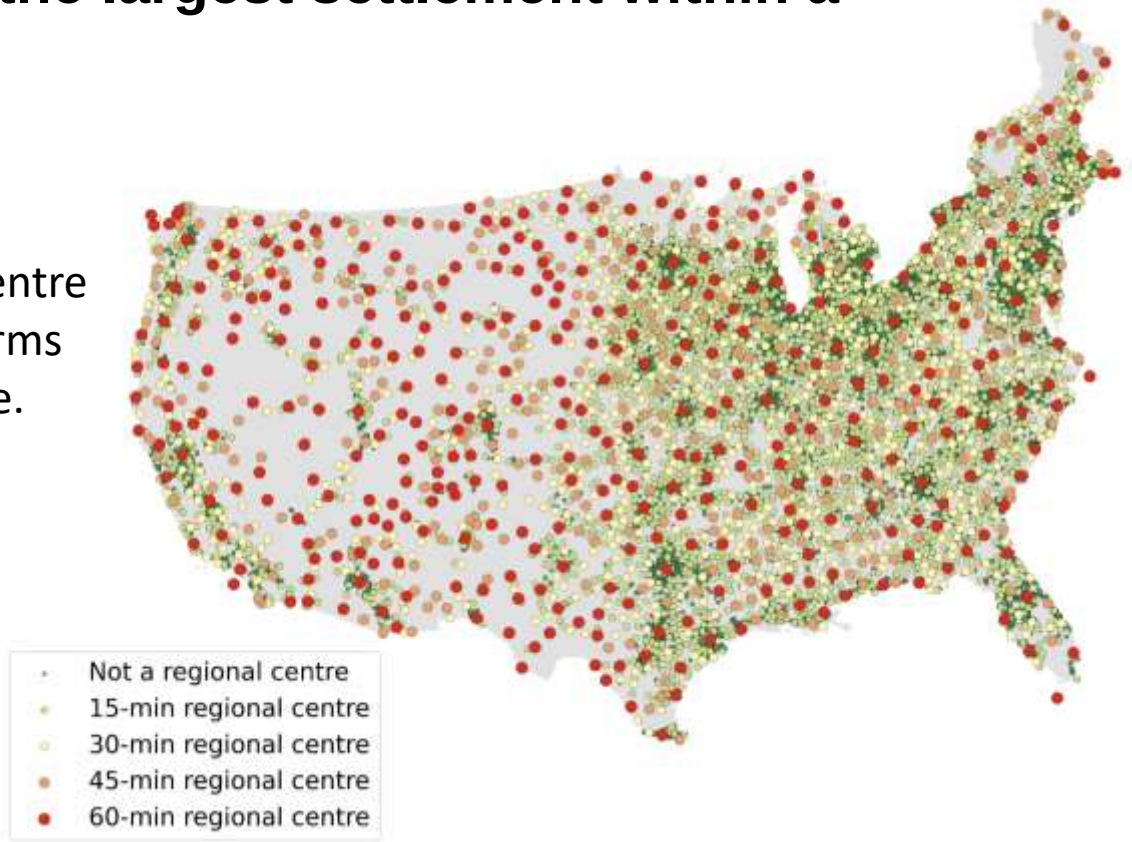
3. Service provision

- Effects of proximity to smaller or larger settlements on services
- More or less than expected based on settlement population?

A regional centre is the largest settlement within a certain driving time

A settlement is a t-minute regional centre if there is no bigger settlement (in terms of population) within a t-minute drive.

We consider **30-minute** drive as the baseline time threshold.



Results from service workstream

- Distance from a city matters for health & finance, less so for education
  - Settlements far from cities tend to have more services themselves

Service	Far from cities	Regional centre
Hospitals	Positive	Positive
Pharmacies	Mostly positive	Positive
Banks	Mostly positive	Positive
Universities	No relationship	Positive
Schools	No relationship	Positive for towns

Service sphere of influence also matters:

- Regional centres are hubs of service provision

Using DEGURBA Around the World: an OECD/EC event

On **June 26**, the OECD hosted a hybrid conference **in Paris**.
Speakers came from European Commission and NSOs around the world:

- New Zealand, South Korea, Turkey
- EC, JRC, OECD, Eurostat
- Brazil, Chile, Colombia, Mexico

Researchers spoke about:

- Reasons for *building* population grids
- Ways of *using* DEGURBA
- Technical & political *obstacles* to implementation

Getting to services: Transport & accessibility

Thursday 26 October, 15-17:00 | DIGITAL EVENT (Zoom)

A discussion of data, methods and applications within & beyond city centres

Featuring:

- Rafael H. M. Pereira, Ipea Brazil
- Hugo Poelman, EC DG-REGIO
- …and other EC & OECD speakers!

Planbureau voor de Leefomgeving

Access for all?

An analysis of (in)accessibility to amenities and jobs in the Netherlands

Dr. Jeroen Bastiaanssen

& Marnix Breedijk

Introduction

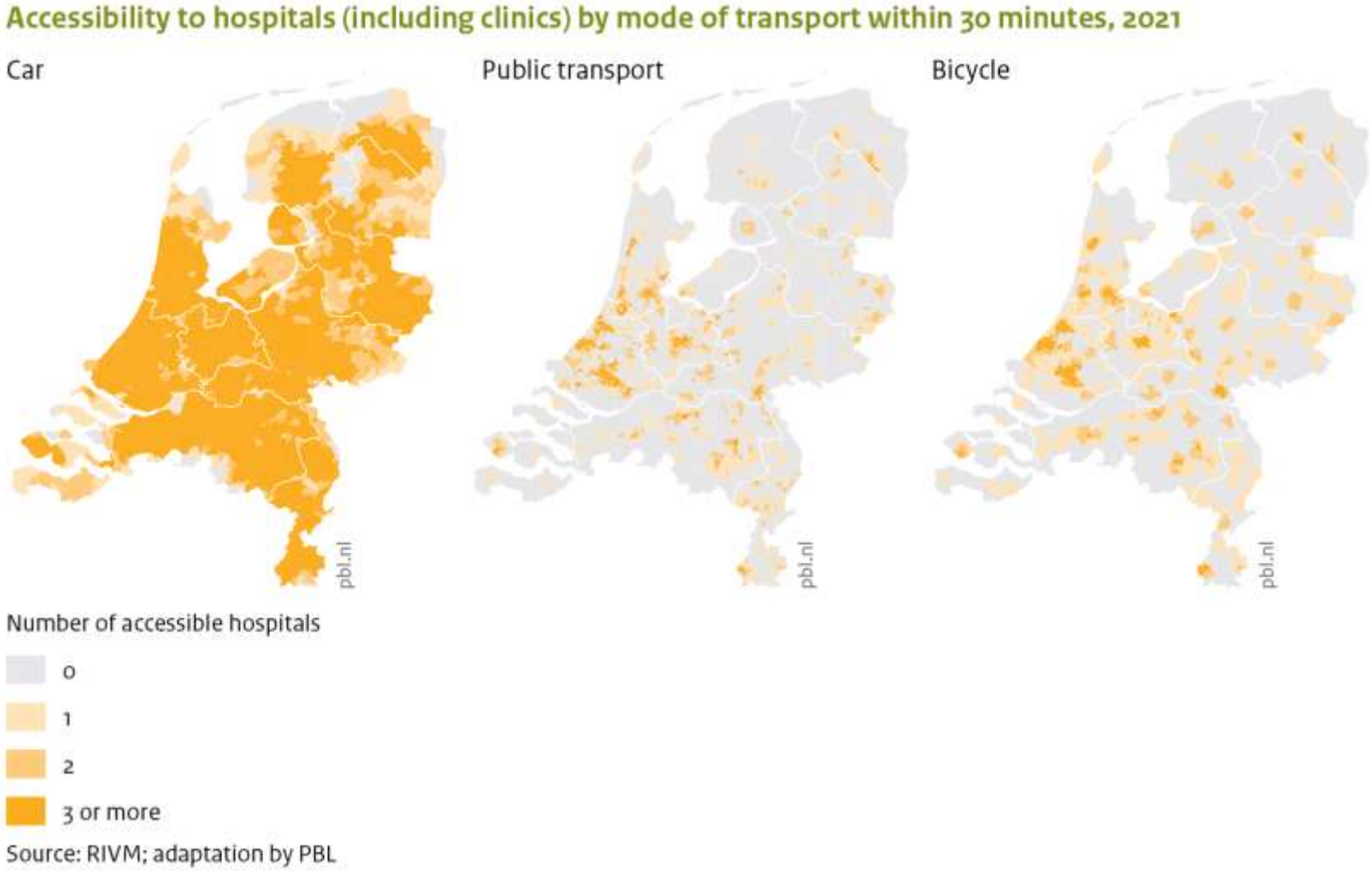
- One of the main objectives of transport policy is to facilitate people's access to jobs, amenities and social contacts.
- Lack of mobility (accessibility) can reduce people’s participation in society: ‘transport poverty’.
- In practice, however, transport policy focuses mainly on reducing congestion, facilitating traffic flows and efficient public transport.
- Dutch National Accessibility Metrics using open data sources to provide insight into neighbourhood-level access to jobs and amenities

Accessibility indicators in 3 steps

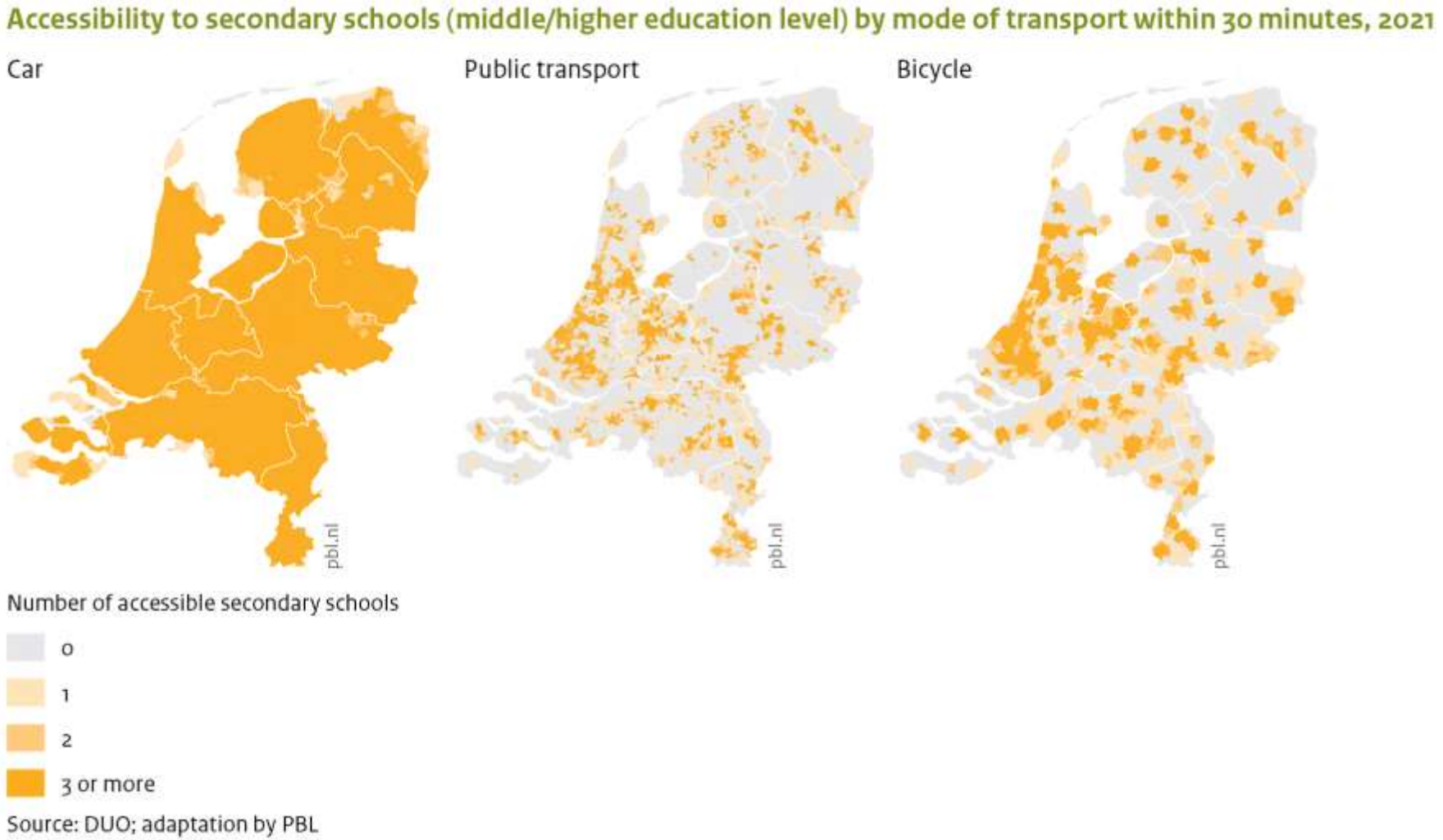
- *Destinations*: addresses of jobs and amenities (health services, schools, supermarkets, parks).
- *Origins*: neighbourhoods (13.900; approx. 700 households in each), combined with administrative micro datasets of population (socioeconomic charteristics, car ownership etc).
- *Travel time analyses*: OSM combined with 'open access' travel time data: Car (Trafficspeed), PT (GTFS), Bicycle (Bike app), Walk (incl. combinations), per time of day (peak/off-peak) and day (Tue/Sun).

Substantial differences in accessibility

- People with access to a car have by far the highest accessibility to amenities and jobs, even during peak hours.
- People who (have to) rely on public transport have considerably less accessibility, especially if they live in rural areas, but also in the urban fringes and suburban areas.
- Although the bicycle contributes to accessibility, in rural areas as well as in suburbs and urban fringes bicycle accessibility of regional amenities and jobs is often limited.



- 30% elderly cannot reach a single hospital or clinic within 30min. travelling by PT, 12% not even within 45min.
- Relates to importance of access to health care for a growing group.



- 17% young people cannot reach a single school for middle/higher education within 30min cycling, 10% no lower eduction school.
- Also affecting freedom of choice: often just one school accessible.

Conclusions

- Accessibility patterns reflect historical choices regarding spatial planning and design of the transport system, but are not invariable.
- At least partially resulting from political choices: shift of jobs and amenities to car locations, PT concentrated in urban corridors.

› Accessibility analyses provide insight into the consequences of these choices for different geographical areas and population groups.

› Analyses form the basis for a debate about possible standards for (minimum levels of) accessibility.

Geographic inequalities in accessibility of essential services

Getting to services: Transport & accessibility - Webinar

October 26th, 2023

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Background and objectives

- Joint EC-OECD project on **geographic inequalities** between the **Directorate for Employment, Labour and Social Affairs** (ELS) and the **Centre for Entrepreneurship, SMEs, Regions and Cities** (CFE)
- Objective: measuring the level of accessibility to:
  - **3 types of services**:
    - Early Childhood Education and Care (ECEC) services
    - Primary schools
    - Public Employment Services (PES)
  - At a **granular level**: OECD small regions (TL3)
  - Ensuring **international comparability**

Data sources and tools

- Location data for services (geographic coordinates or addresses)
  - Bilateral correspondence with national authorities
  - Publicly available data on national authorities' websites

- Routing API
  - Mapbox Isochrone API

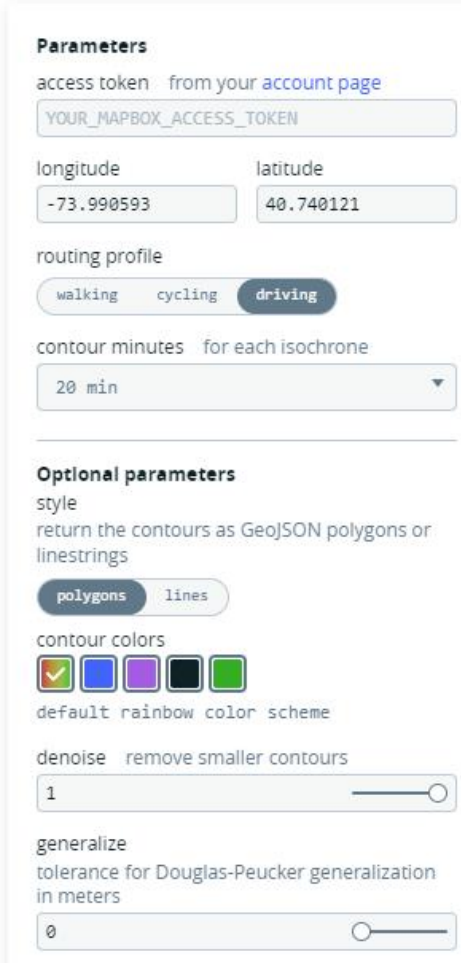
- Population grid
  - GHS population grid

- Python (main packages: *geocoder, requests*, *geopandas* and *rasterstats*)

The Mapbox Isochrone API

- The Mapbox Isochrone API provides the **area that can be reached within a certain time**
  - Up to 60 minutes
  - Using 3 modes of transport: walking, cycling and driving

- Access obtained through the development data partnership



Source: © Mapbox © OpenStreetMap https://docs.mapbox.com/playground/isochrone/

2 types of accessibility indicators

Share of population having access to at least one facility

- **Walking** and **driving**
- **15 and 30-minute** time thresholds

Travel time to the nearest facility

- **Walking** and **driving**
- Measured with **5-minute intervals**
- Computed for the **bottom 20%**, **median** and **top 20%** of the population

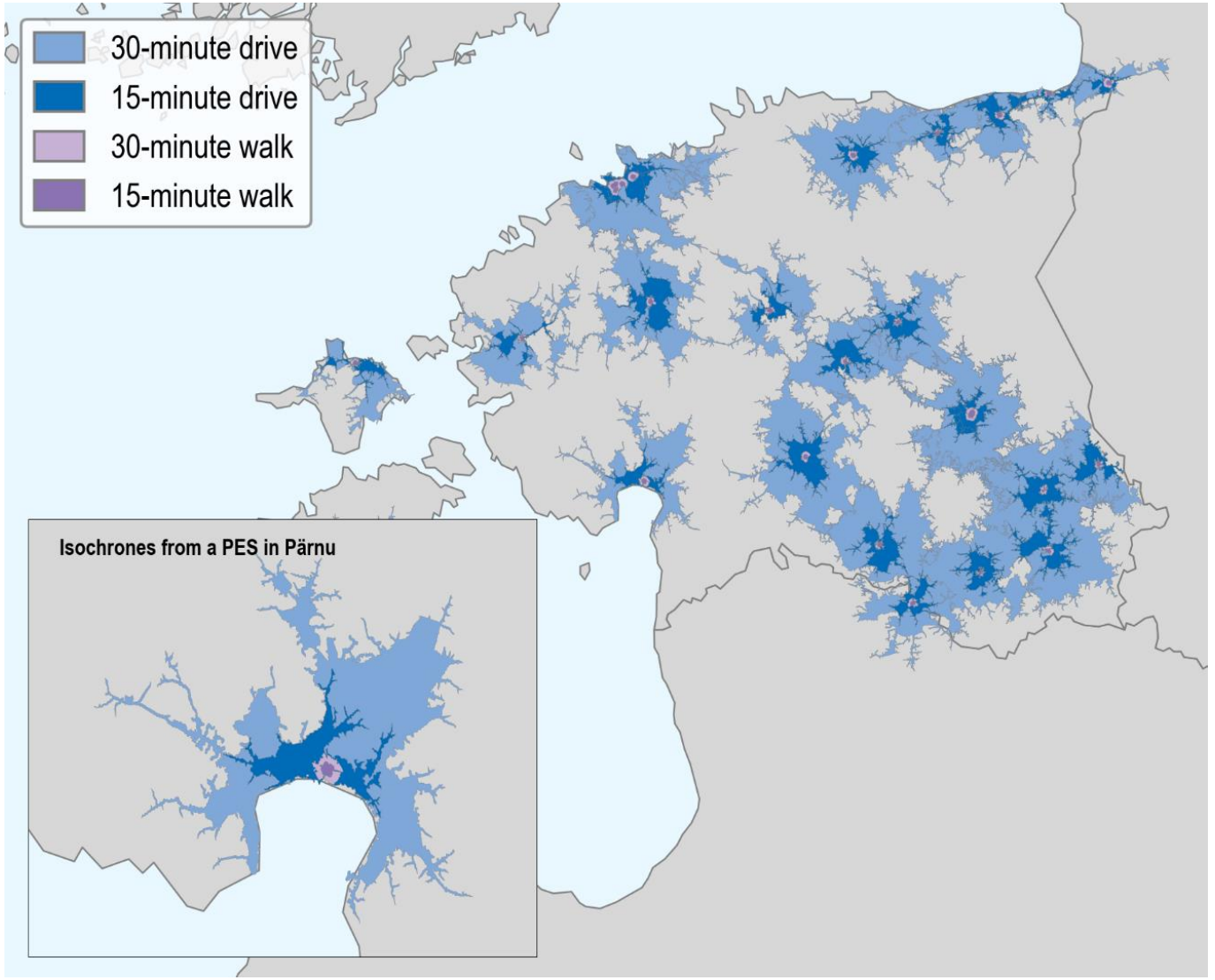
Methodology

(share of population indicators)

- Use Mapbox API to determine the **area within reach of a service point in a 15’ and 30’ walk or drive** (isochrones)

- Dissolve isochrones and calculate **share of population with access** to each service within a 15’ and 30’ walk or drive in each TL3 region using a 1x1 km population grid

Isochrone polygons from PES facilities in Estonia



Methodology

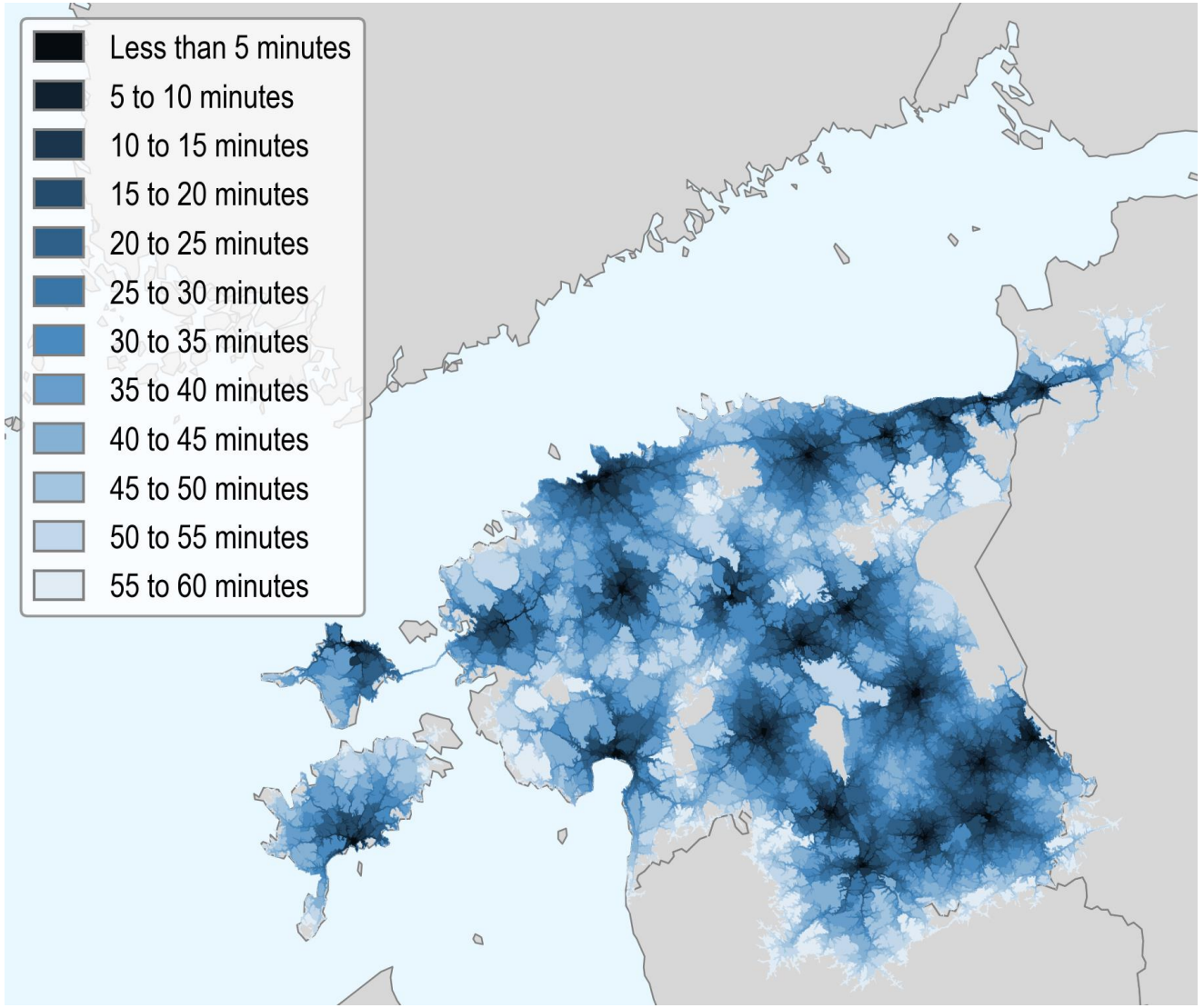
(median travel time indicators)

- Use Mapbox API to determine the **area within reach of a service point for the 12 5-minute intervals** (50 to 60 minutes)

- Dissolve isochrones and calculate the **population within each 5-minute interval** in each TL3 region.

- **Extract travel times** for the bottom 20%, median and top 20% of the population

Driving isochrone polygons from PES facilities in Estonia



API requests for each type of indicator

- An API request contains:
  - **1 pair of coordinates** (e.g. for a primary school)
  - **1 transport mode** (e.g. driving)
  - Up to **4 time thresholds** (5, 10, 15, 30 minutes)
- In a country with 1 000 primary schools…

Share of population having access to at least one facility

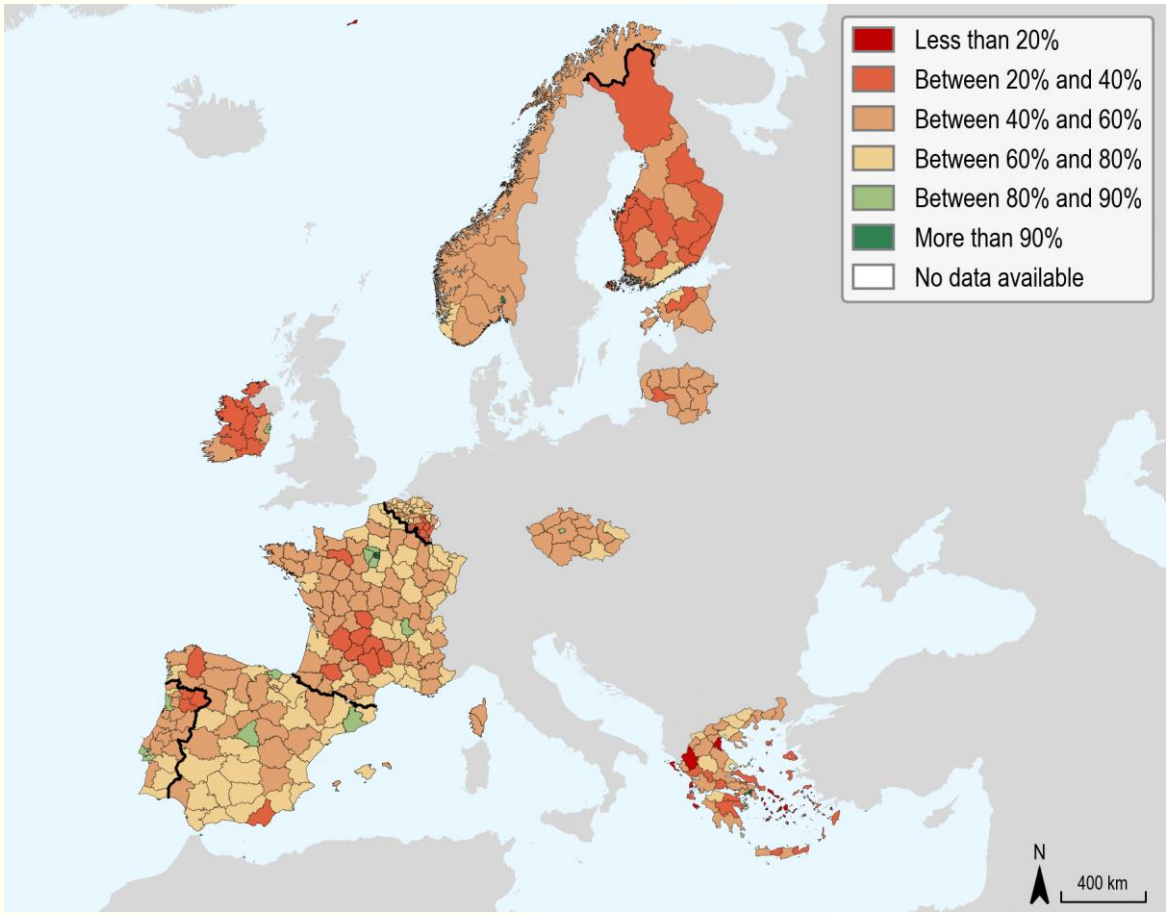
→ **1 000 API requests** per mode

Median travel time to the nearest facility

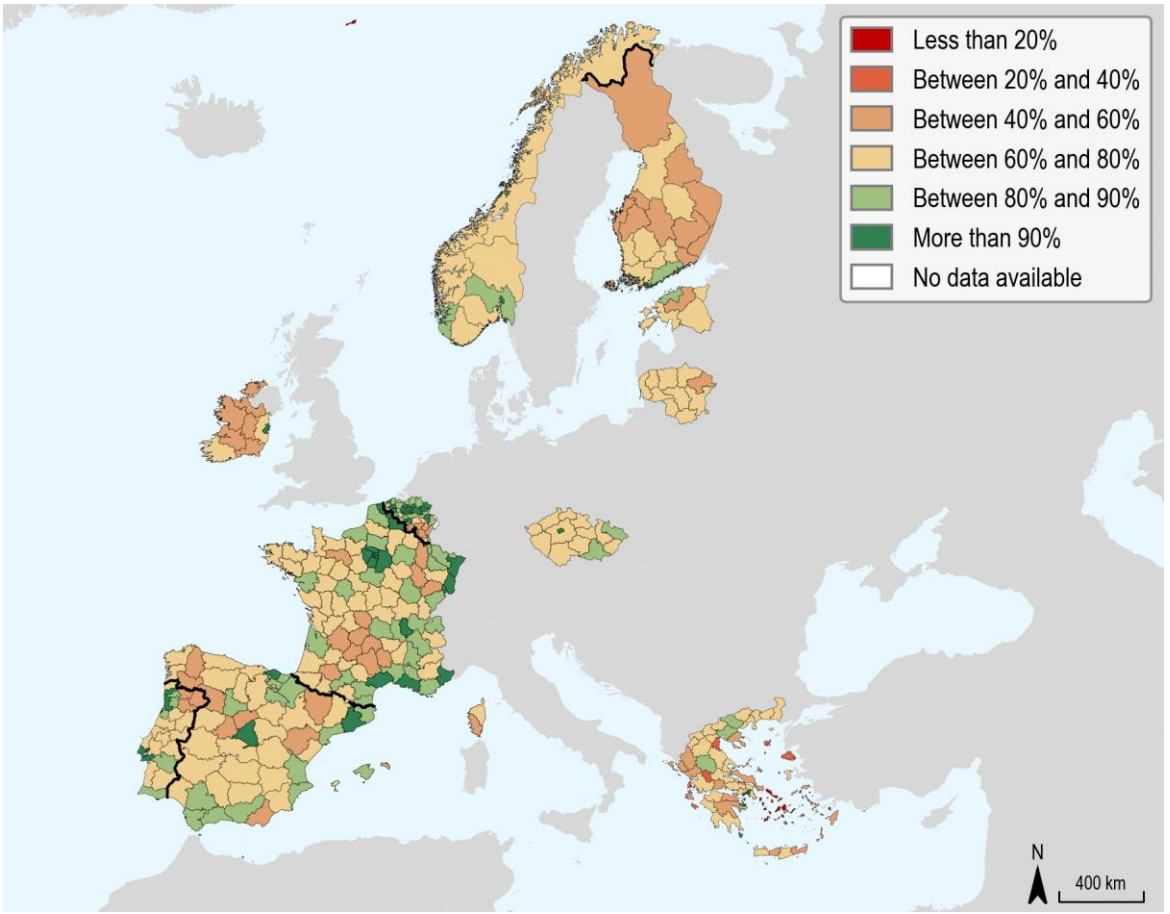
- 5-minute intervals → **3 000 API requests** (3 batches of 4 time thresholds) per mode
- 1-minute intervals → **15 000 API requests** (15 batches of 4 time thresholds) per mode

Share of population with access to a primary school within a…

15-minute walk

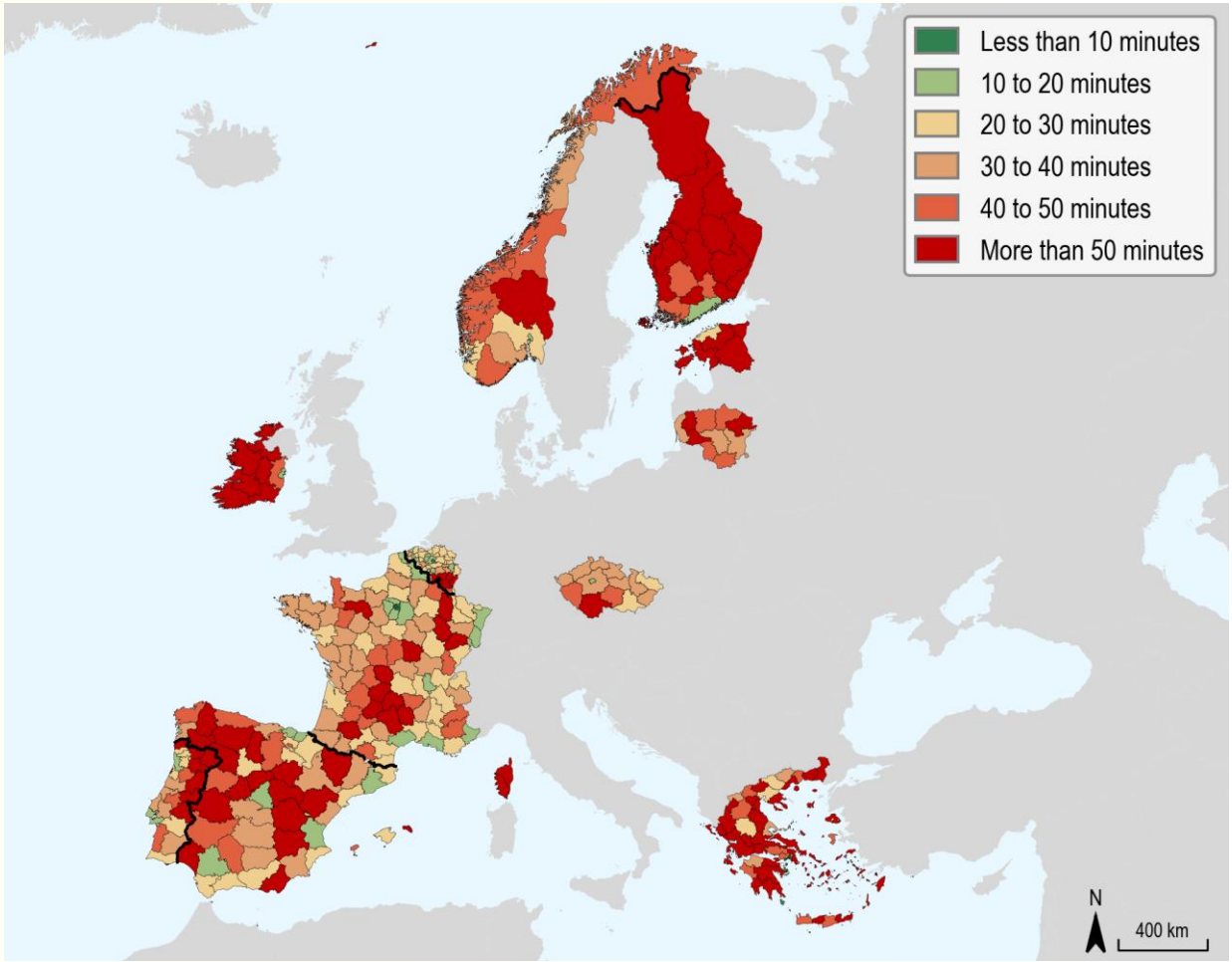


30-minute walk

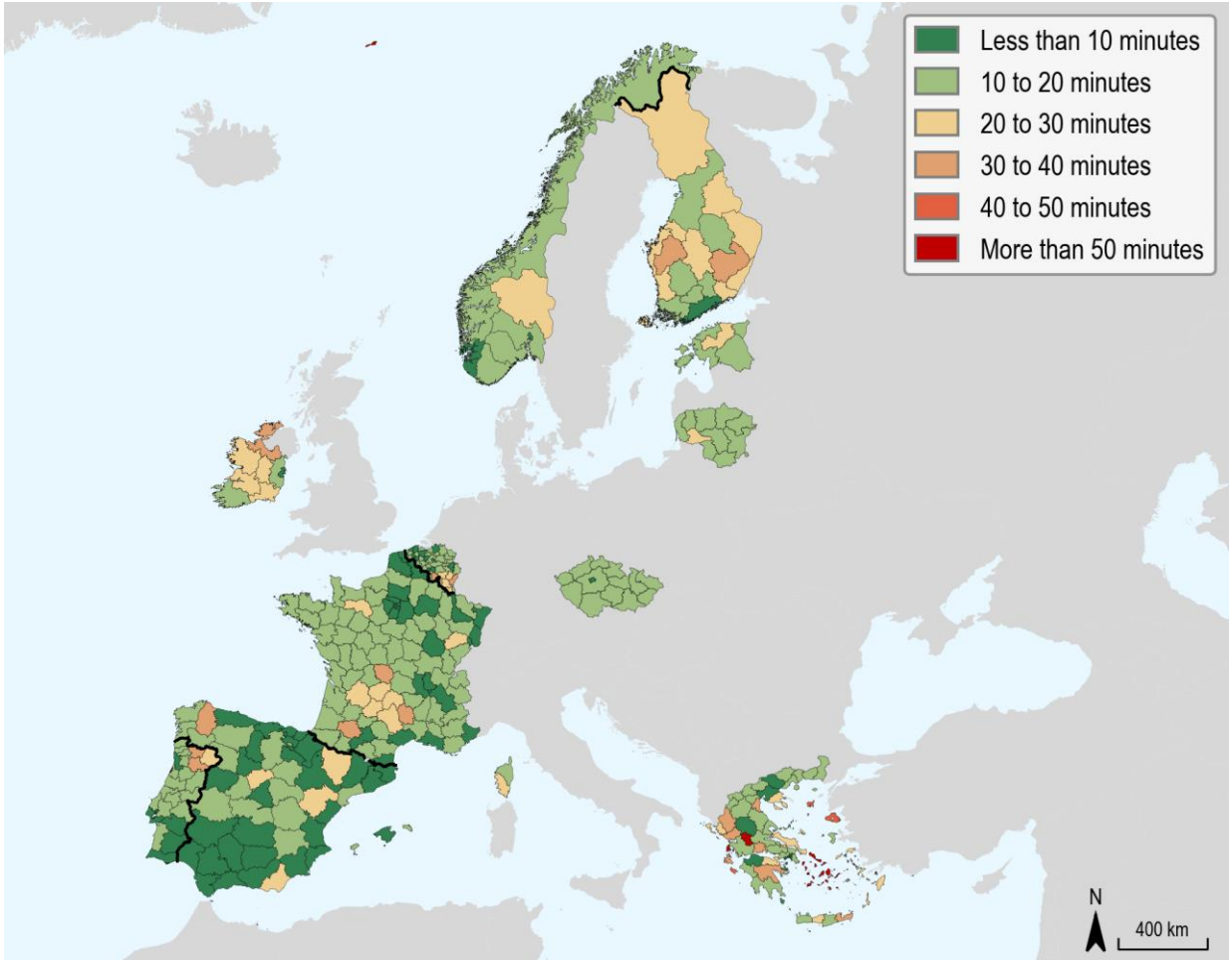


Walking time to the nearest school for…

someone in the bottom 20%



the median person



Challenges and limitations (data sources)

- **Services data**
  - **Limited availability**: only few countries publish location data
  - Limited information on the **capacity, quality or affordability**
  - **Definitions differ** across countries (e.g. school levels)
  - Not yet possible to track **changes over time**
- **Routing API**
  - No accessibility by **public transport**
  - **Traffic** not taken into account
  - The number of API requests limits the **precision of travel time indicators**

Challenges and limitations (analysis)

- Comparability of TL3 regions for assessing accessibility to services?
  - TL3 regions classified by access-to-cities do not account for differences in **settlements' pattern** within regions
  - It also raises the question of the appropriate **transport mode**

- The **degree of urbanisation** would allow taking into account **within-region differences**
  - How to **combine these 2 classifications** in a simple and clear way?

Thank you!

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