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Methodological issues in the development of accessibility measures to services: challenges and possible solutions in the Canadian context

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Outline

- Objectives of this presentation
- Concept of accessibility used in this analysis
- Some key methodological challenges
- Possible solutions in the Canadian context
- Results of model testing



Objectives of this presentation

- Outline some methodological issues related to the development of accessibility measures to selected services
- Present possible methodological solutions in the Canadian context, which might be relevant to the experience of other member countries and might generate discussion and further ideas for the development of these accessibility measures

Concept of accessibility

- The concept of “accessibility” has been used to capture the possibility to access specific services or infrastructures (*access to something*)

- In the literature:
 - Various dimensions of accessibility have been considered: physical, economic, social accessibility
 - Accessibility measures have been developed for different units of observation: from the individual level to the regional level.

- In this analysis, the focus is on:
 - Physical access to selected services
 - A measure at the municipal level (Census subdivision, CSD)
 - A continuous measure (as opposed to a categorical measure)

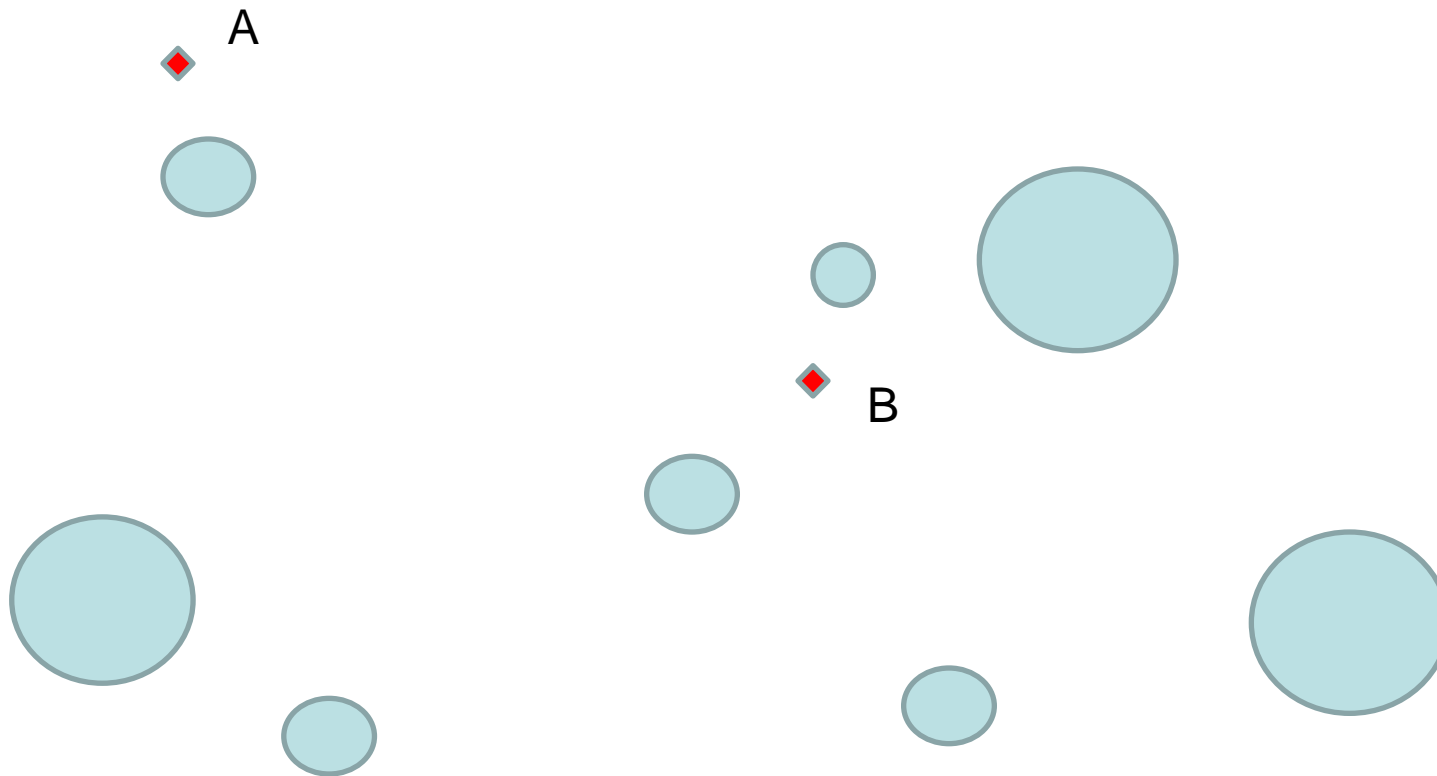


Methodological challenges: access to multiple points of service provision

- Measures of accessibility are often implemented by taking into account access to services at one single point in space (closest point of access)
- This approach might not capture the overall regional context in which a community is located
- Depending on the geographic context in which the measure is developed, this might result in similar values of the measure for communities that have substantially different possibilities of access to a given service

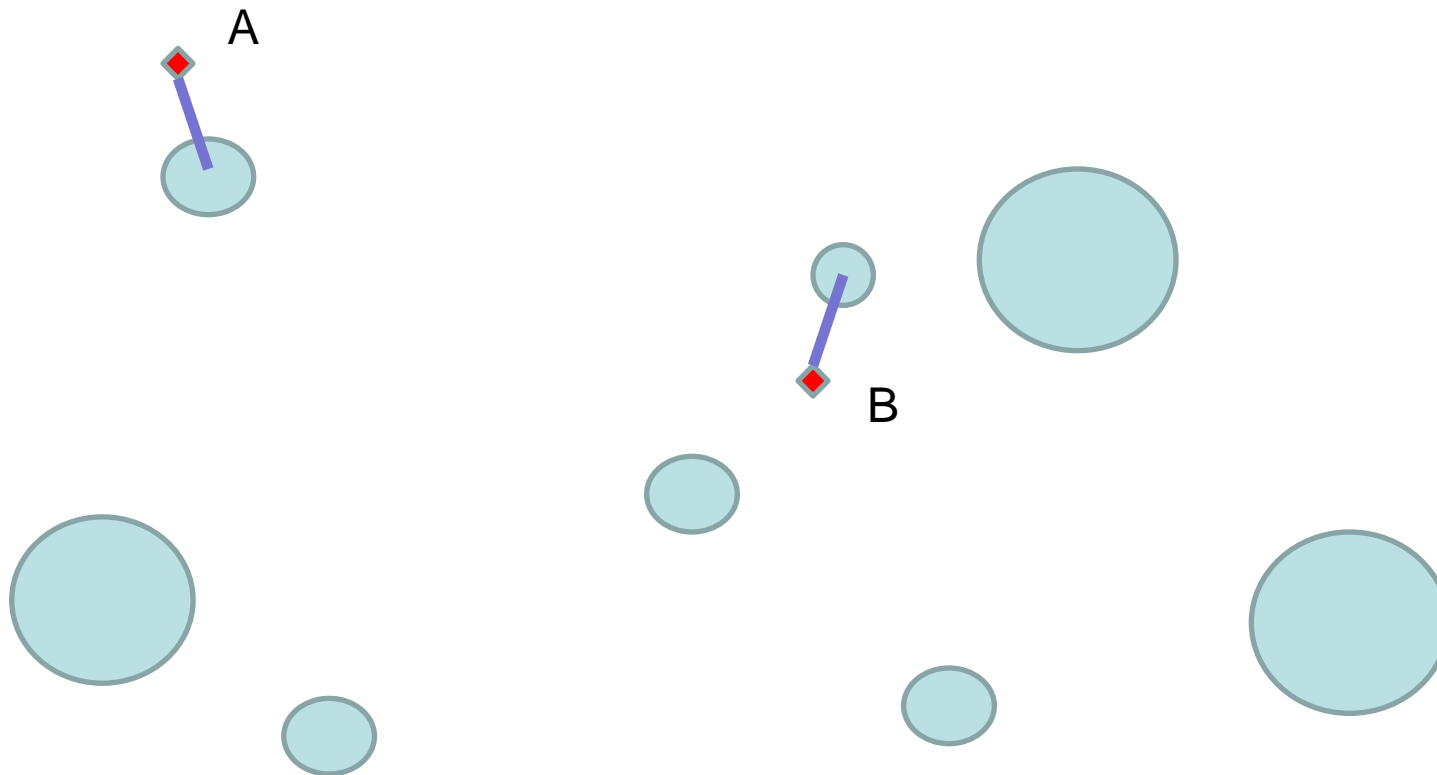


A schematic representation of the issue



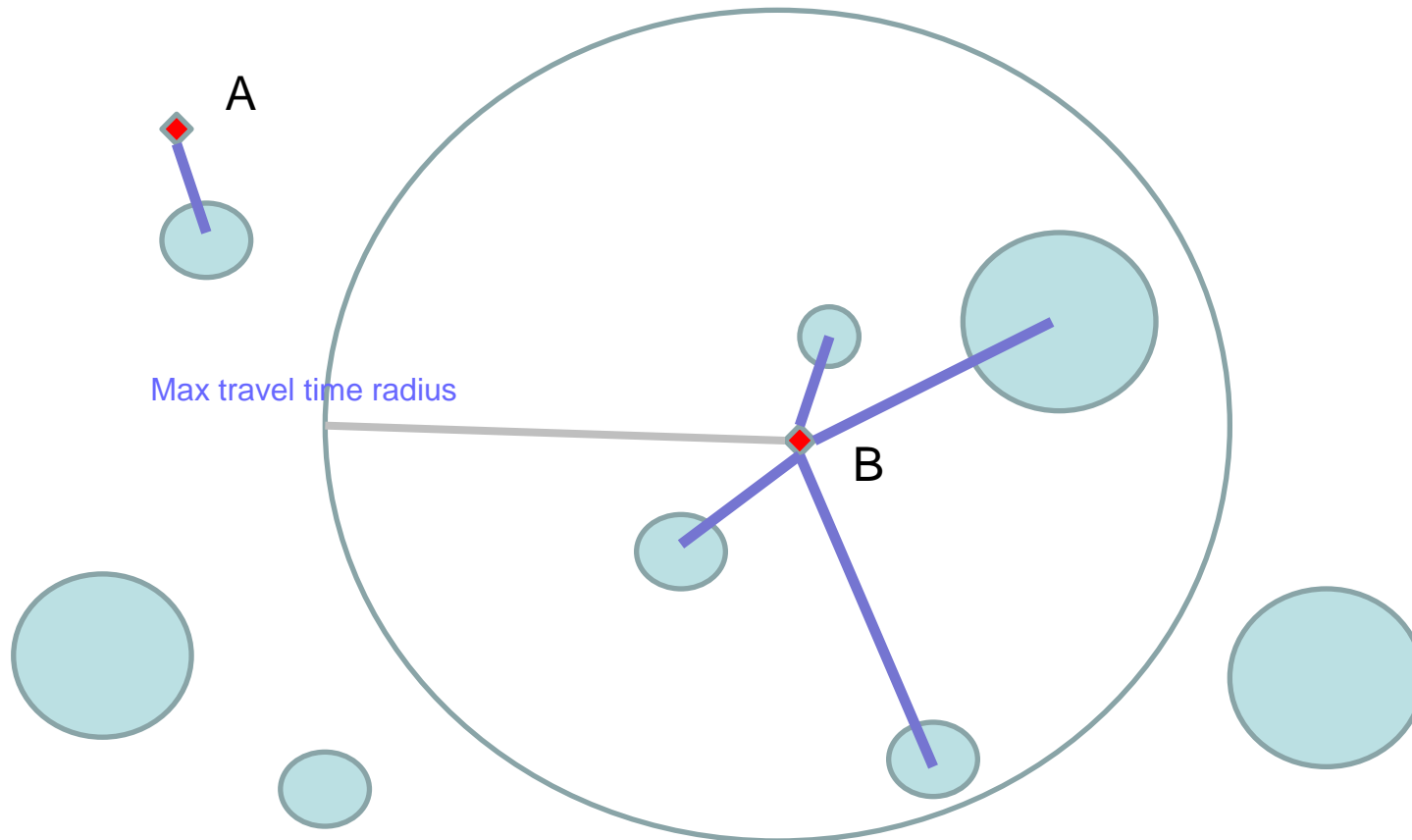


A schematic representation of the issue: which of the two communities has “more access” to services?





A schematic representation of the issue: which of the two communities has “more access” to services?





Methodological challenges: data requirements

- When considering multiple points of access, data requirements are generally demanding
- For example: in the Canadian context, a measure of geographic proximity between each pair of municipalities **connected through the main road network** requires computing between 4 and 5 million data points, depending on the threshold for maximum travel distance (a full matrix of distances between all municipalities is approximately 27 million data points)
- This might call for innovative thinking in the direction of so-called “Big Data”, i.e., high volume and variety of data not normally associated with the data produced by an official statistical program

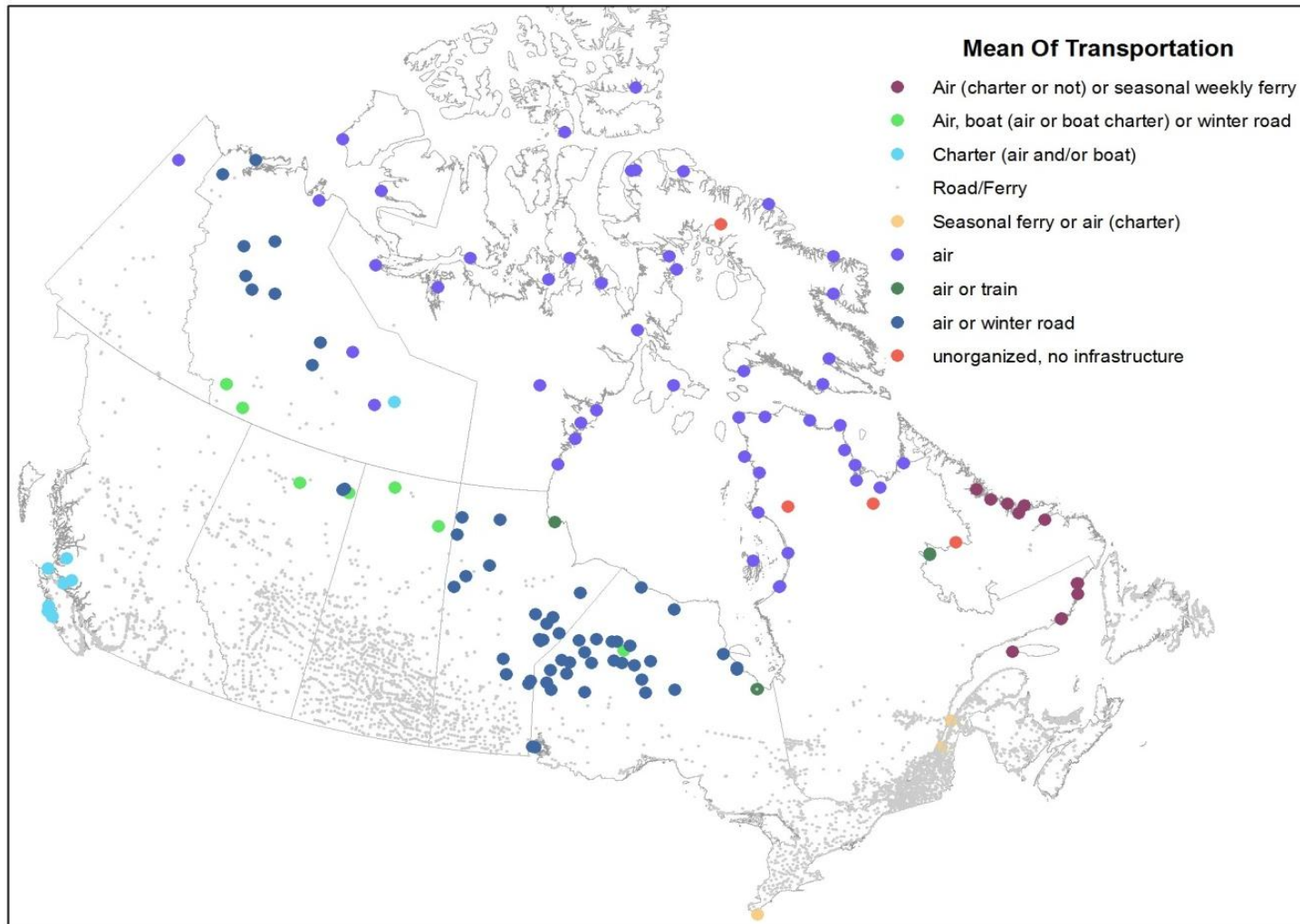


Methodological challenges: measure of physical accessibility

- Proximity can be measured by travel distance, travel time, travel cost
- Challenge: find a unit of measure of proximity that can be applied to communities that have different transportation infrastructures. The main distinction is between:
 - Communities connected to the main road network
 - Communities not connected to the main road network (fly-in communities, ferry connection, winter roads, train).
 - In Canada, there are 149 communities (CSD) reporting some population in the census 2011, which are not connected to the main road network



Type of transportation infrastructures available in the community (CSD), for non-connected communities



Proposed approach: general model

- An accessibility measure based on the principle of a gravity model that accounts for two dimensions:
 - Travel time (as measure of proximity) between one CSD and all CSDs within 150 minutes travel time from the CSD of reference (travel time is calculated from representative points located in the most populated area of the CSD)
 - Size of services provided in the CSD (measured by total revenue for selected NAICS codes at the CSD level)

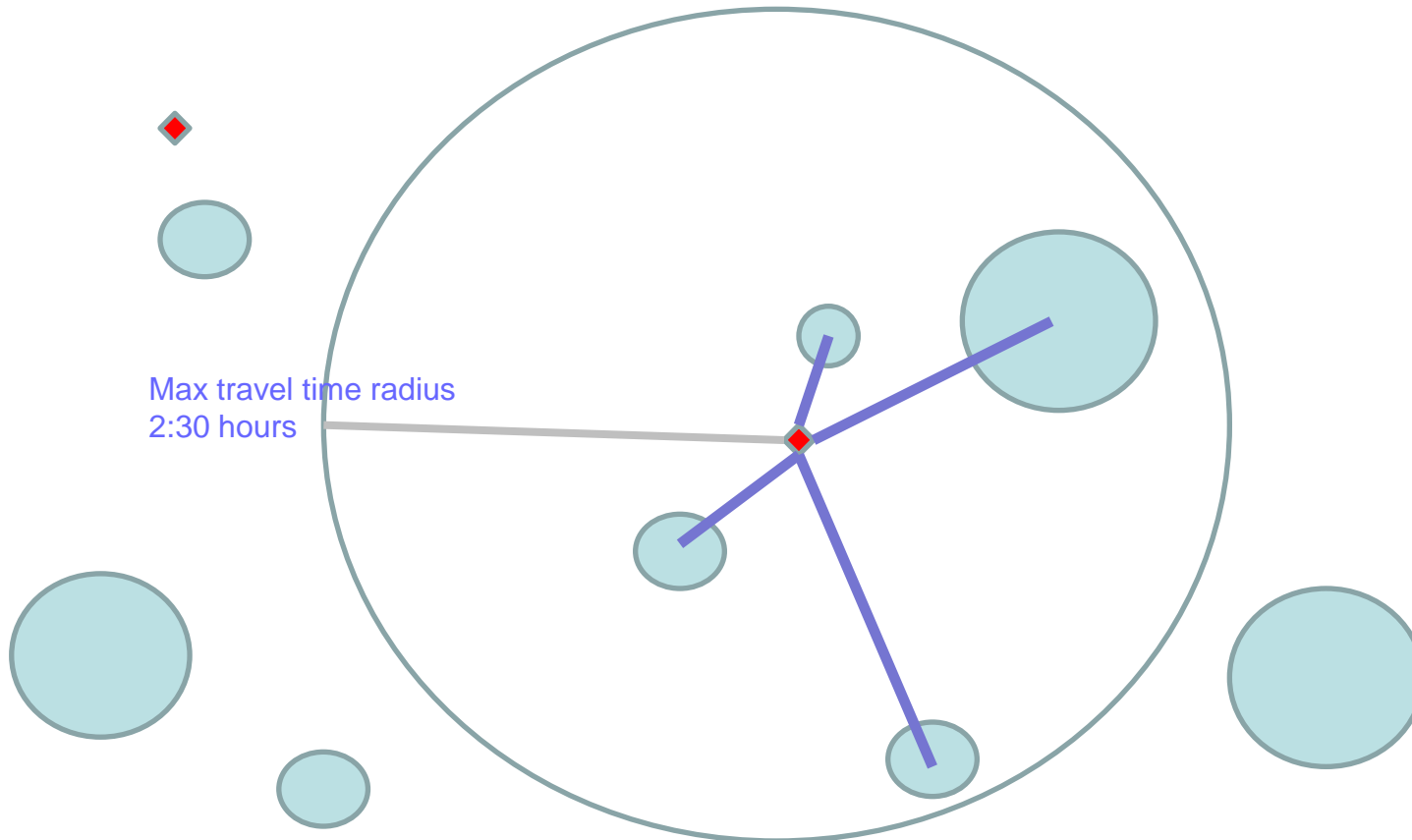
In mathematical terms:

$$AM_i = \ln \sum_{k=1}^n \left(\frac{TotRev_k}{T_{i,k}} \right)$$

with $T_{i,k} = 3.75$ if $T_{i,k} \leq 3.75$, and for all $T_{i,k} < 150$ minutes

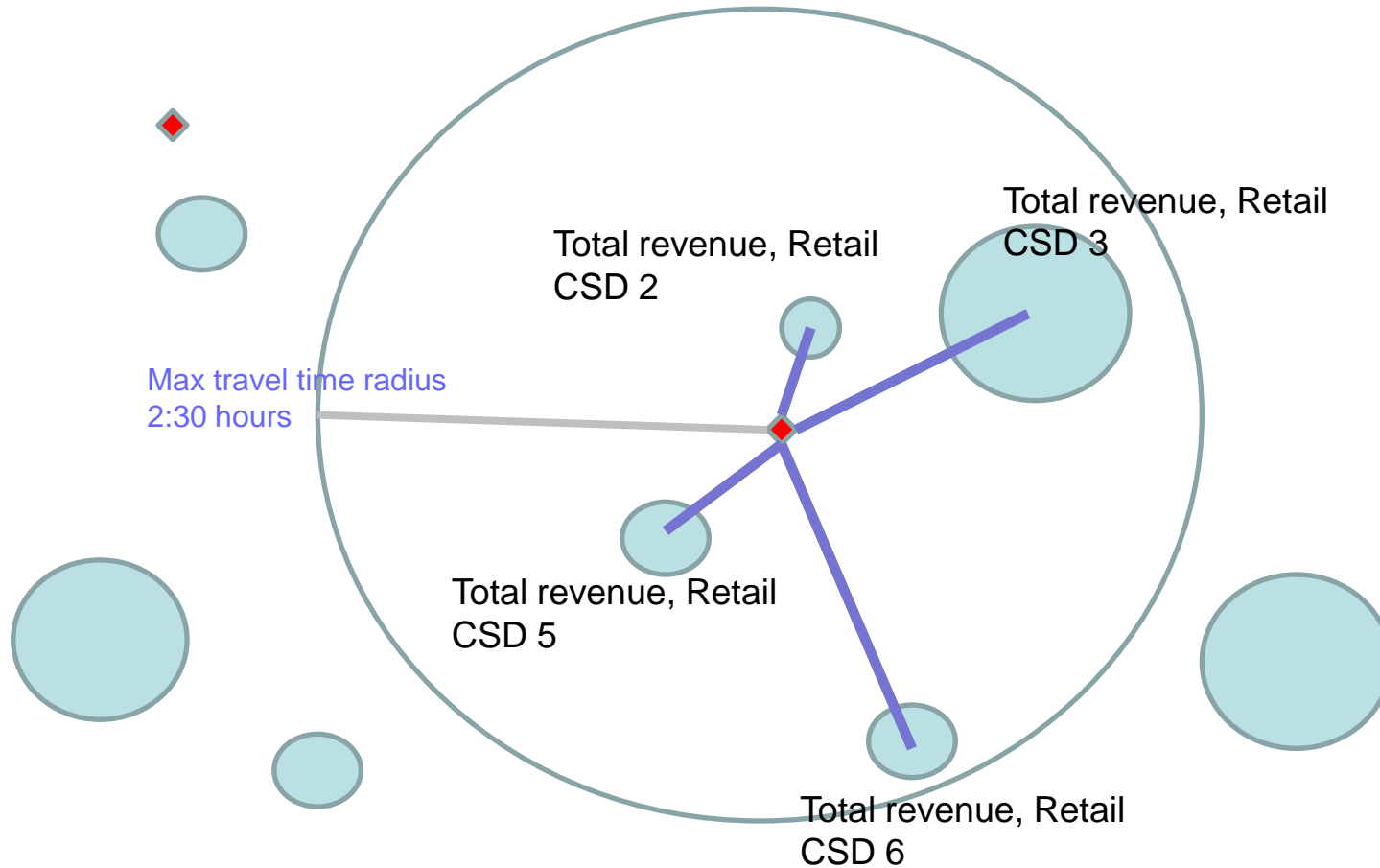


Schematic representation



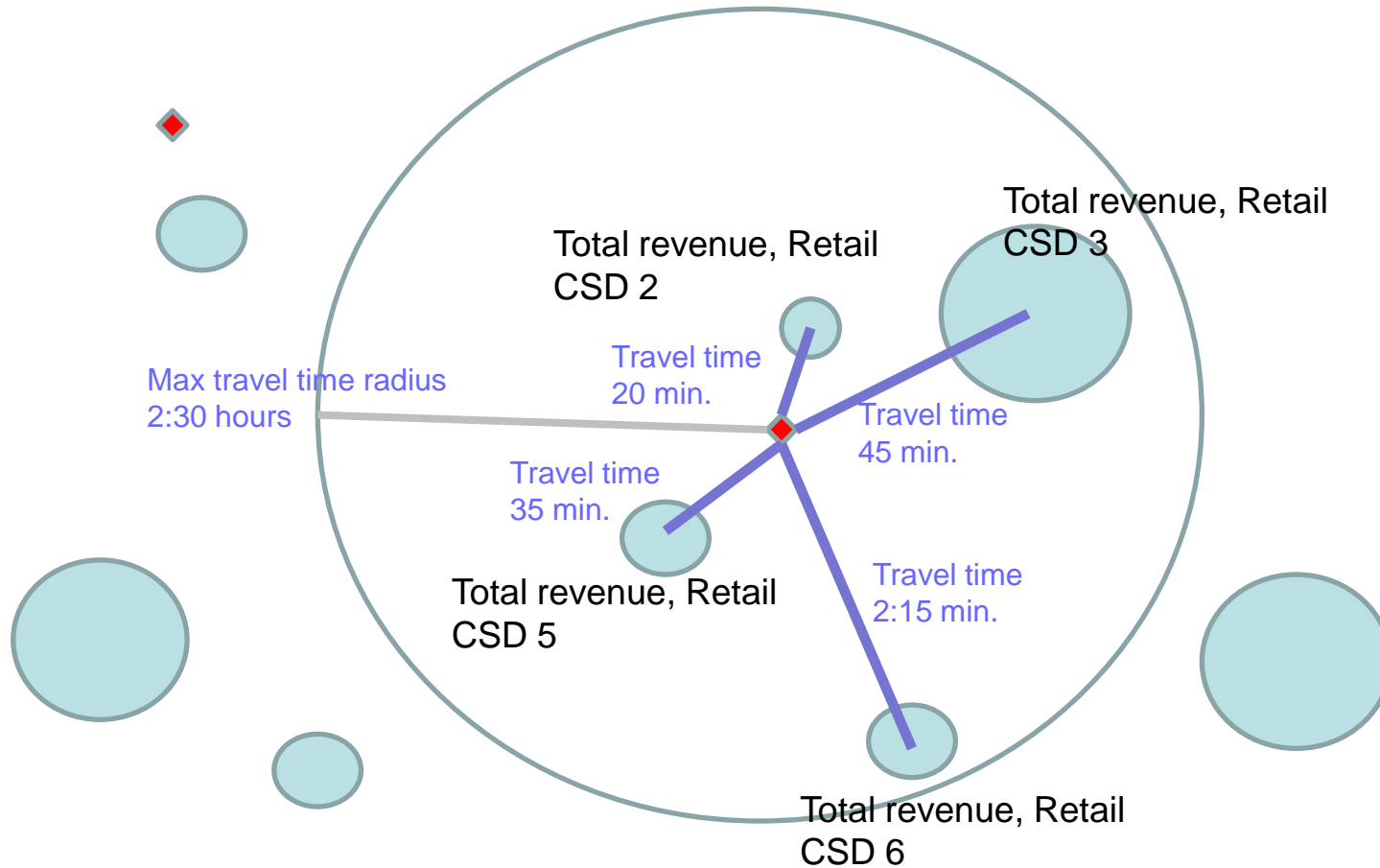


Schematic representation





Schematic representation





Proposed approach: data sources

- Google Maps Distance Matrix API
 - The road network is classified by road type, speed limit, and type of surface
 - The network includes regular ferries
 - Travel distance and travel time can be retrieved
 - Travel time gives a more accurate measure of proximity because it accounts for differences in the quality of the road network and the possible presence of part of the itinerary in which ferries must be used
 - The high volume of computations required the use of the enterprise licence of Google Maps Distance Matrix API
- Presence and size of selected services: the data sources is the Business Register of Statistics Canada
 - The Business Register (BR) serves as a central data source to access a consistent and well maintained inventory of businesses with national coverage
 - Establishments in the Business Register are coded based on the concept of major business activity using the North American Industry Classification System (NAICS)
 - BR revenue microdata for selected NAICS coded were aggregated at the CSD level

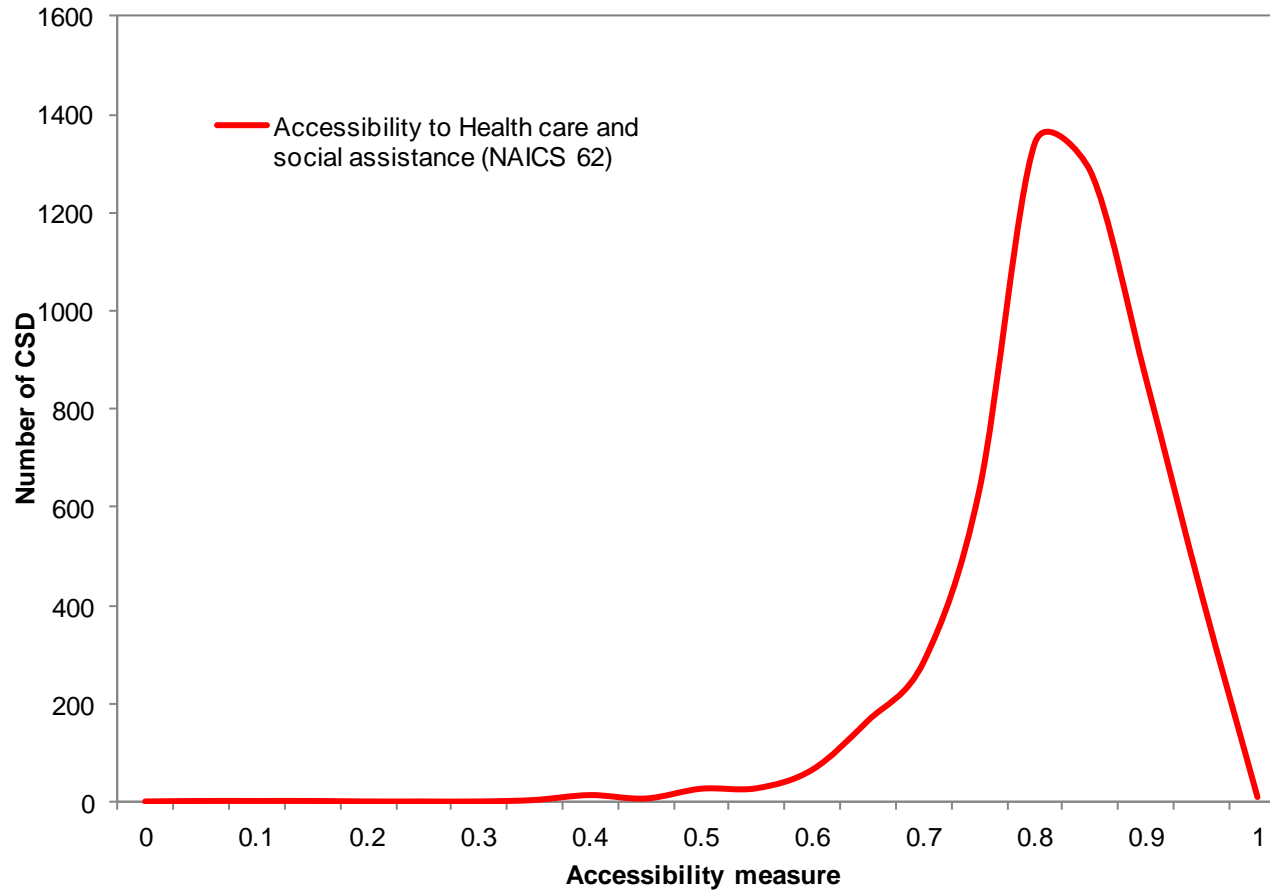


Proposed approach: proximity measures

- Connected versus non-connected communities
 - At this stage, the non-connected communities with no service within the community are identified as communities with “no direct access”
 - Alternative approach: convert travel time into travel cost
 - Using CAA estimate of travel costs for road transportation
 - Using *ad hoc* database and econometric estimation for non-road transportation
- The model was tested for 13 accessibility measures, covering health services, banking and legal services, selected retail services, transportation services, public administration, and educational facilities



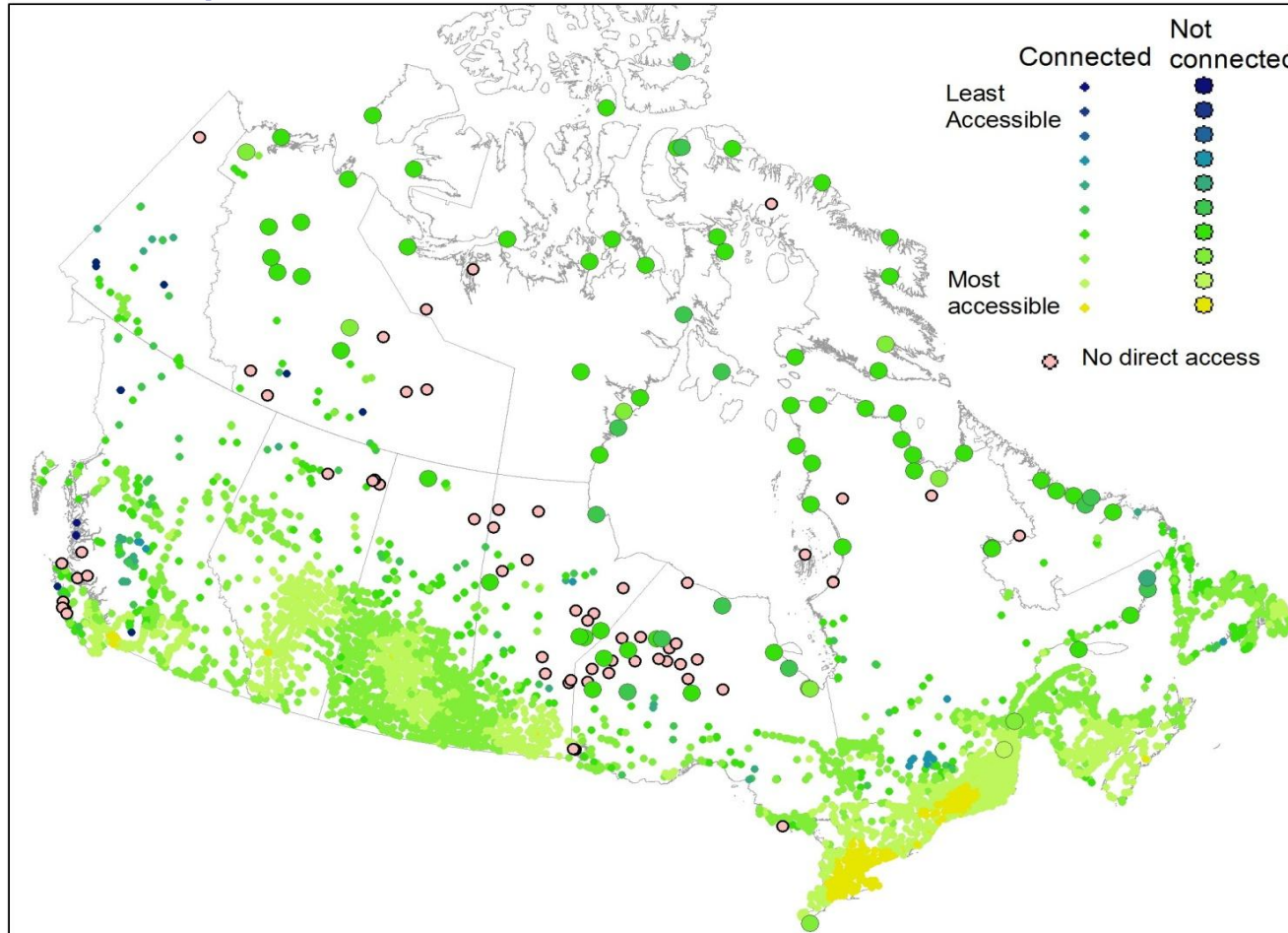
Example: accessibility measure to Health care and social assistance (NAICS code 62)



Note: the measure is rescaled to the range (0, 1), with 1 corresponding to the maximum value of the accessibility measure.



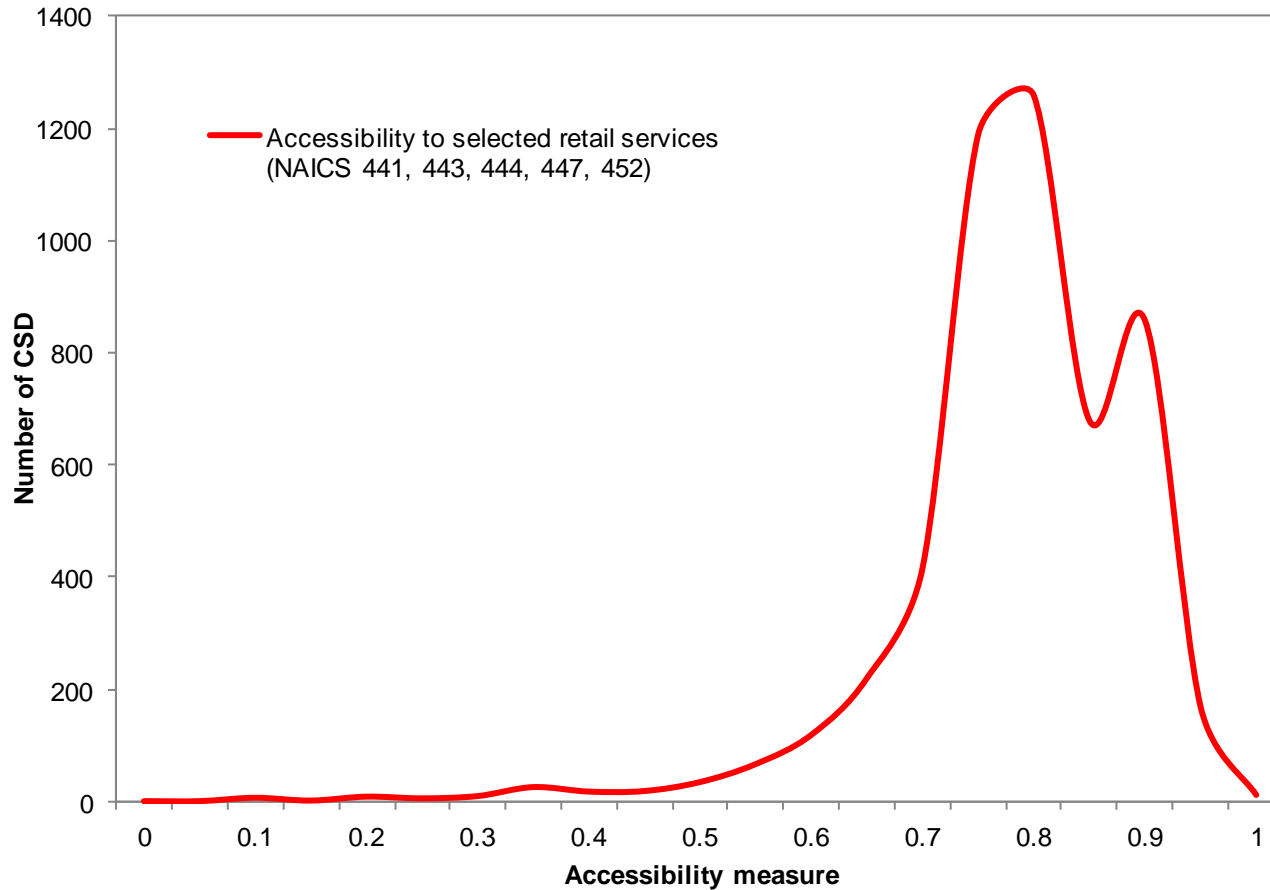
Example: accessibility measure to Health care and social assistance (NAICS code 62)



Note: each dot represents a CSD. Mapping is done using ten classes, each representing 0.1 increments of the measure, ranging from 0 to 1.



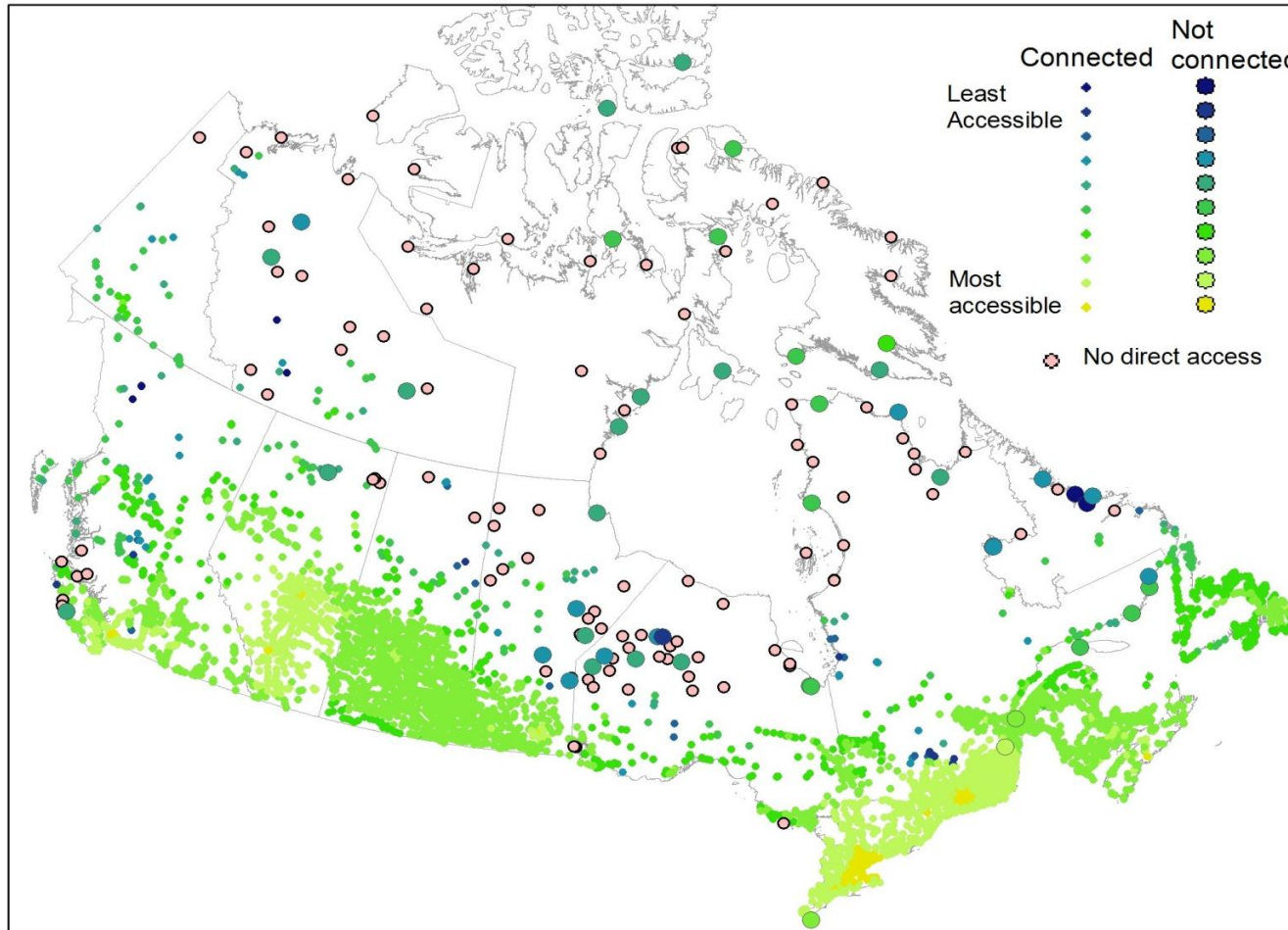
Example: accessibility measure to selected retail services (NAICS 441, 443, 444, 447, 452)



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Conclusion

- The methodology presented here is still under refinement
- Several variations of the general model could be implemented to address the needs of specific users; for instance:
 - Focus on presence/absence of services with selected characteristics
 - Use alternative measures of size for the service (e.g. employment)
 - Use of per-capita values instead of aggregate values to measure the size of service provision
- Lesson learned: explore the potential for use of data that are not normally associated with an official statistical program in combination with official statistics



Thank you for your attention