

# Using Mobile Network Big Data for Informing Transportation and Urban Planning in Colombo

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*CPRsouth 2014*

Maropeng, South Africa

12 September 2014



This work was carried out with the aid of a grant from the International Development Research Centre, Canada and the Department for International Development UK.



# Policy implication

- Mobile network big data represents a viable source for **timely** and **policy relevant evidence** for transportation and urban planning
  - In developing economies, it is a **cheaper** alternative to the extant imperfect data sources

# Effective transportation and urban planning needs data

- Many data needs:
  - Spatio-temporal population density changes
  - Spatio-temporal mobility patterns
  - Land use patterns
  - Etc.
- With minimal use of sensors, developing economies rely on infrequent and expensive surveys to fulfill their data needs

# The data: historical and anonymized Call Detail Records (CDRs) from Sri Lanka

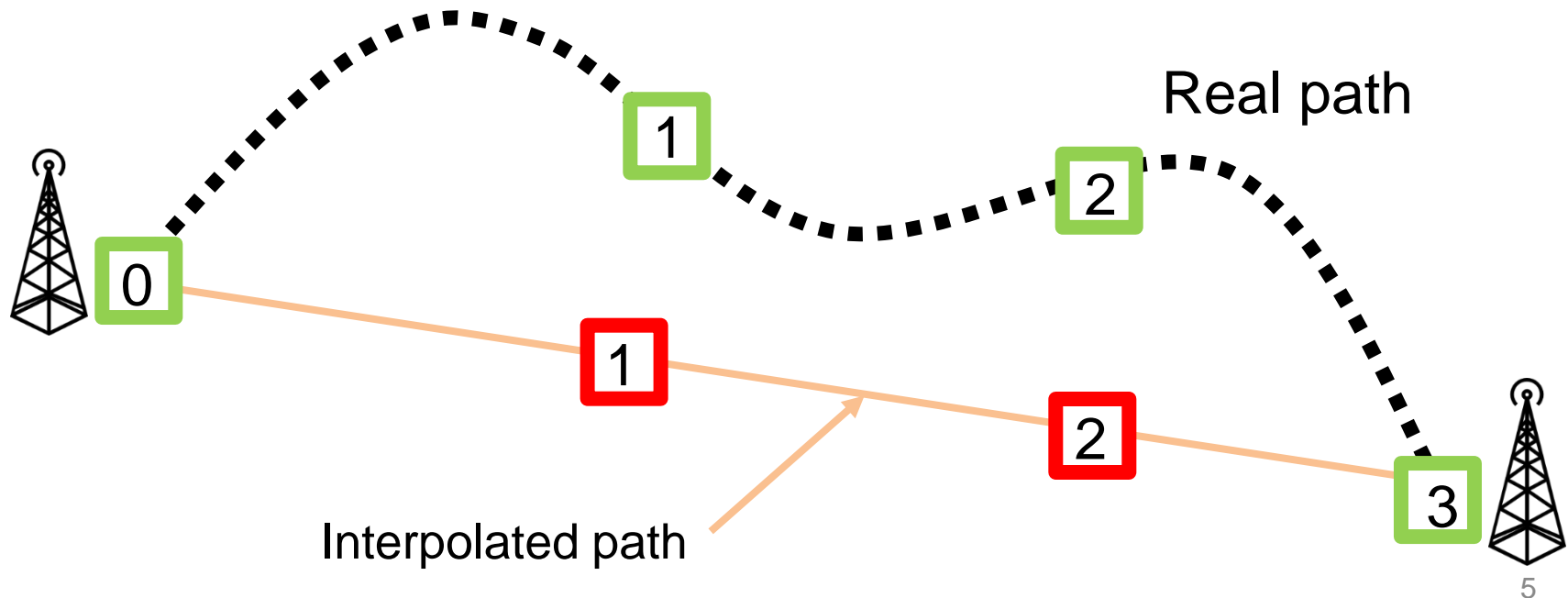
- Call Detail Record (CDR):
  - Records of all calls made and received by a person created mainly for the purposes of billing
  - Similar records exist for all SMS-es sent and received as well as for all Internet sessions

Calling Party Number	Called Party Number	Caller Cell ID	Call Time	Call Duration
A24BC1571X	B321SG141X	3134	13-04-2013 17:42:14	00:03:35

- The Cell ID in turn has a lat-long position associated with it
- CDR data for 4 contiguous months in 2012-2013
  - Covers 5 to 10 million SIMs
  - Over 6 billion records of calls made and received

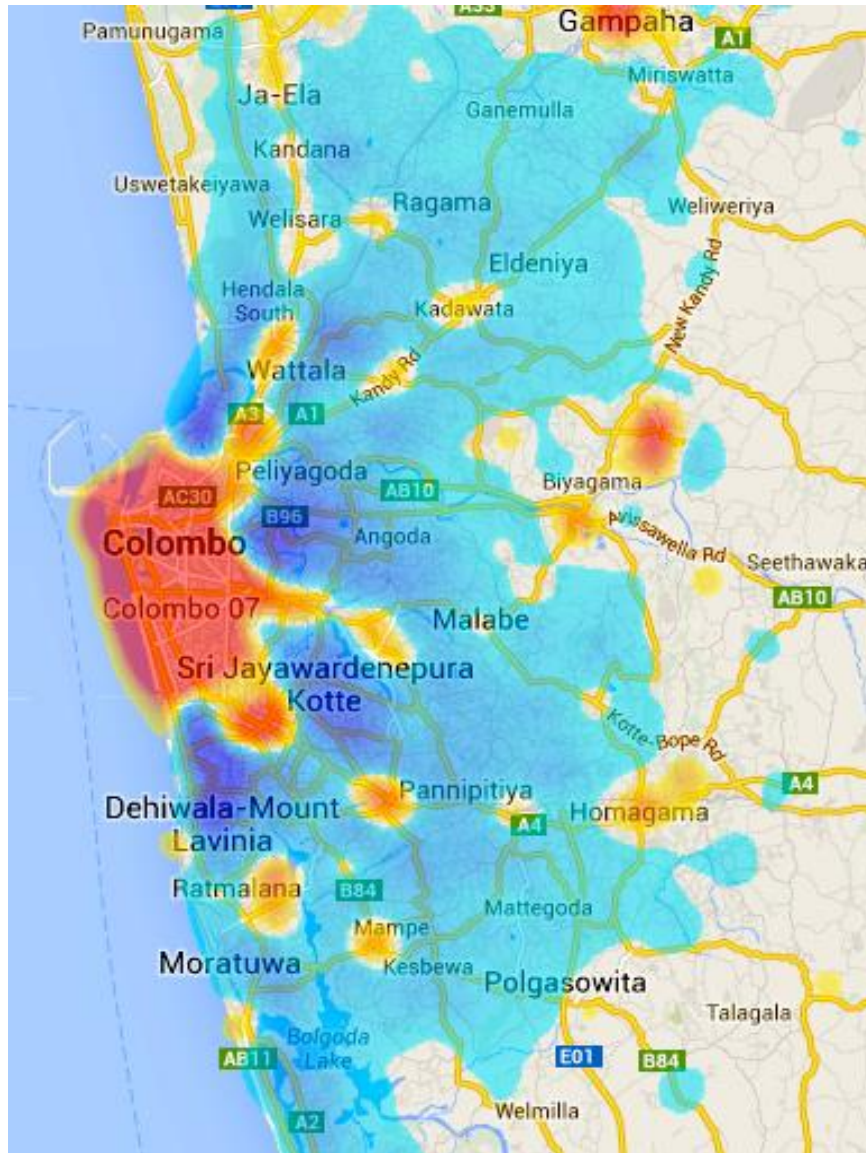
# Understanding changes in population density: methodology

- We estimate an average location for **everyone**, for **every hour**
- Linearly interpolate location:



*Key: the number in the box are time periods*

# Colombo seems to be sink for the people from the surrounding regions



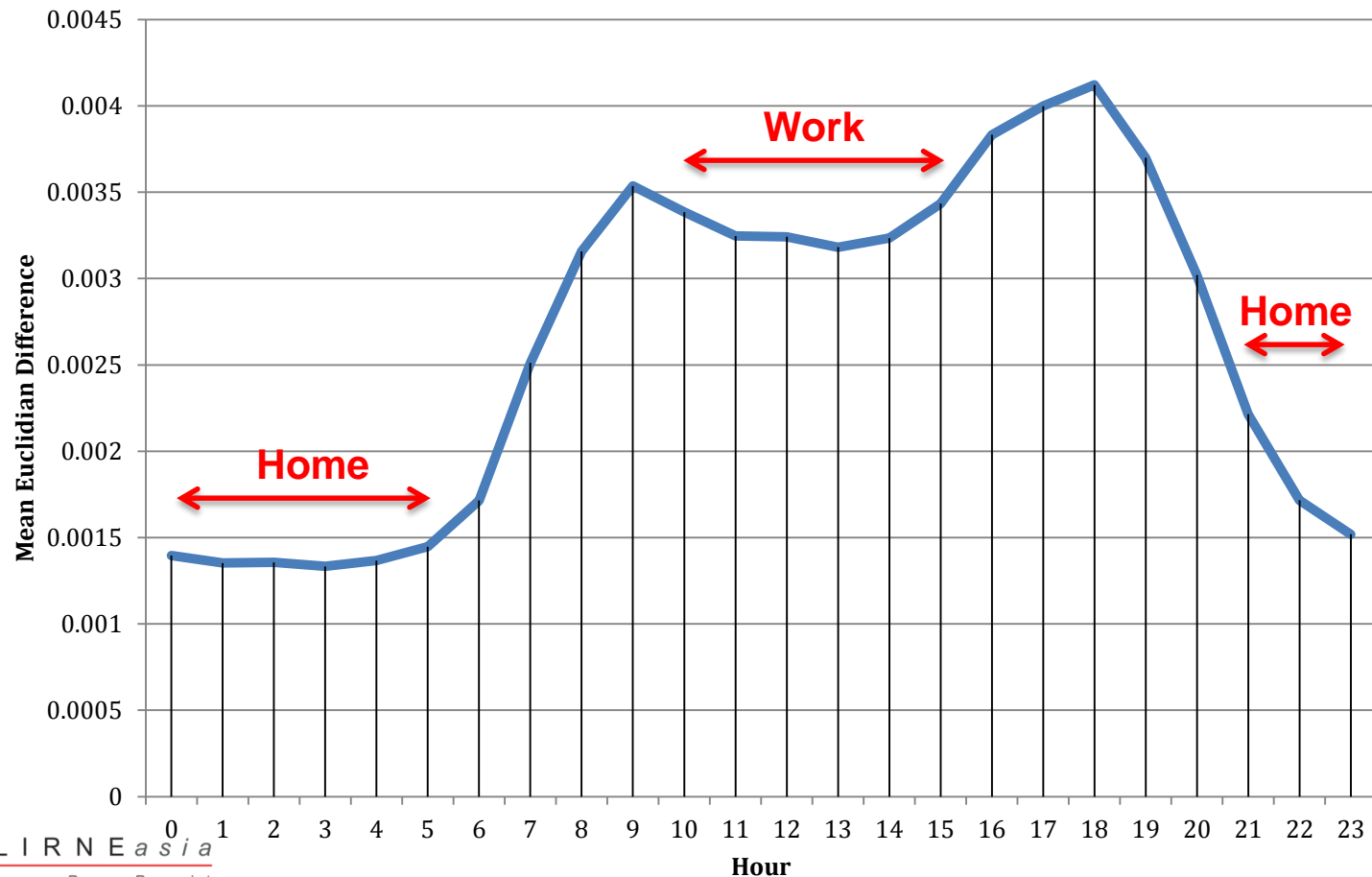
- The image on the left depicts relative density of people in Colombo city and the surrounding regions at 1300 compared to 0000 (midnight the previous day) on a normal weekday.
- The yellow to red colors depict areas whose density has increased relative to midnight. The blue color depicts areas whose density has decreased relative to midnight (the darker the blue, the greater the loss in density). The clear areas are those where the overall density has not changed.

# Understanding where people live and where they work: methodology

- Choose time frames for home and work
- Calculate a home and work location for each SIM:
  - Match cell towers to Divisional Secretariat Division (DSD)
  - Count each DSD at most once per *day*.
  - Pick the DSD with the largest number of “hits”
  - For work consider only weekdays and non-public holidays
- Methodology based on the following (with some modifications):
  - Isaacman, S., Becker, R., Cáceres, R., Kobourov, S., Martonosi, M., Rowland, J., & Varshavsky, A. (2011). Identifying Important Places in People’s Lives from Cellular Network Data. In K. Lyons, J. Hightower, & E. M. Huang (Eds.), *Pervasive Computing: Lecture Notes in Computer Science* (Vol. 6696, pp. 133–151)
  - Calabrese, F., Di Lorenzo, G., Liu, L., & Ratti, C. (2011). Estimating Origin-Destination Flows Using Mobile Phone Location Data. *IEEE Pervasive Computing*, 10(4), 36–44
  - Cáceres, N., Wideberg, J. P., & Benitez, F. G. (2007). Deriving origin–destination data from a mobile phone network. *IET Intelligent Transport Systems*, 1

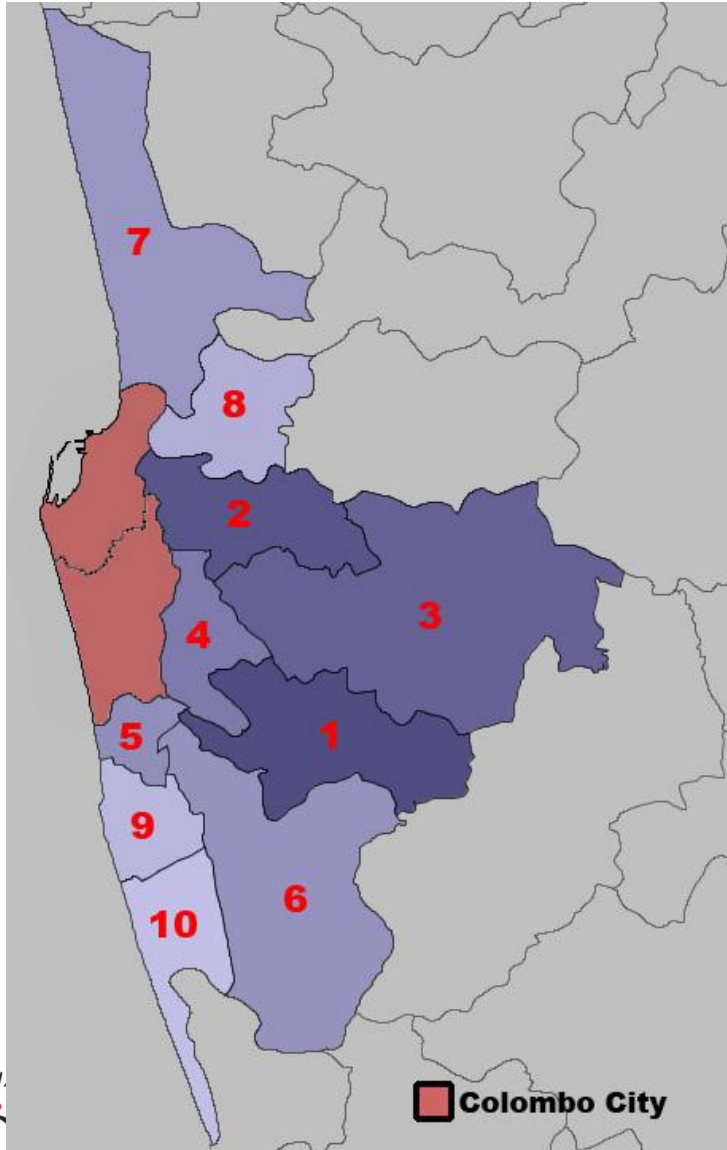
# Home and work times were chosen based on an analyses of average mobility in interpolated data

- Home time: 2100 to 0500
- Work time: 1000 to 1500





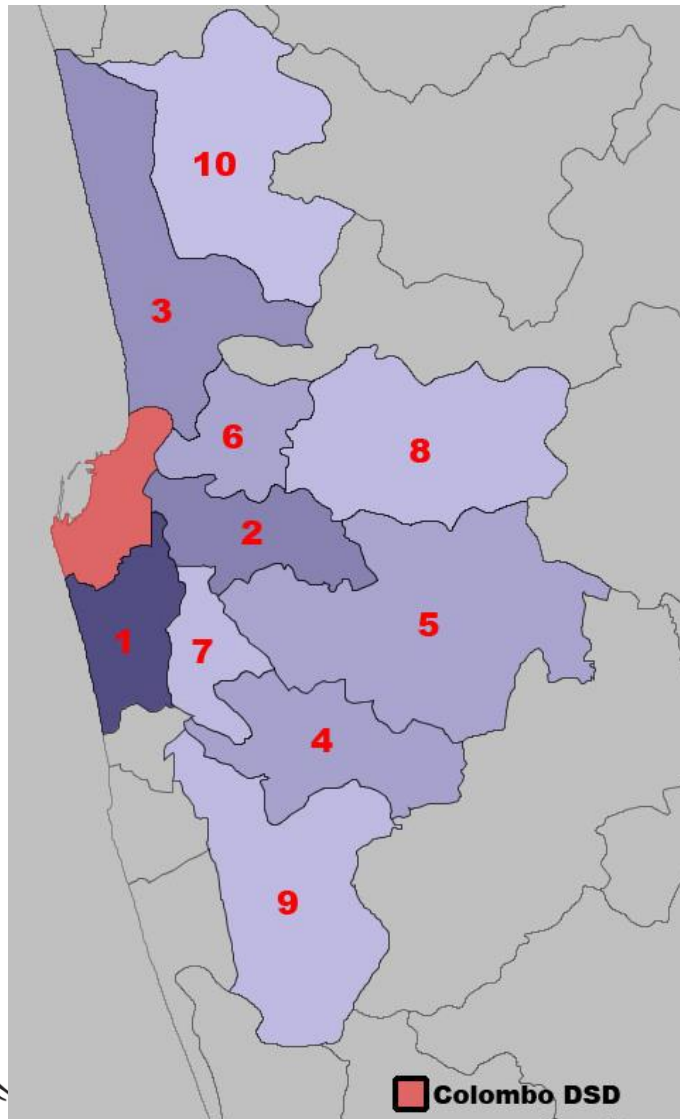
# At least 46.9% of **Colombo city's** daytime population comes from the surrounding regions



Colombo city is made up of Colombo DSD and Thimbirigasyaya DSD

Home DSD	%age of Colombo's daytime population
Colombo city	53.1
1. Maharagama	3.7
2. Kolonnawa	3.5
3. Kaduwela	3.3
4. Sri Jayawardanapura Kotte	2.9
5. Dehiwala	2.6
6. Kesbewa	2.5
7. Wattala	2.5
8. Kelaniya	2.1
9. Ratmalana	2.0
10. Moratuwa	1.8

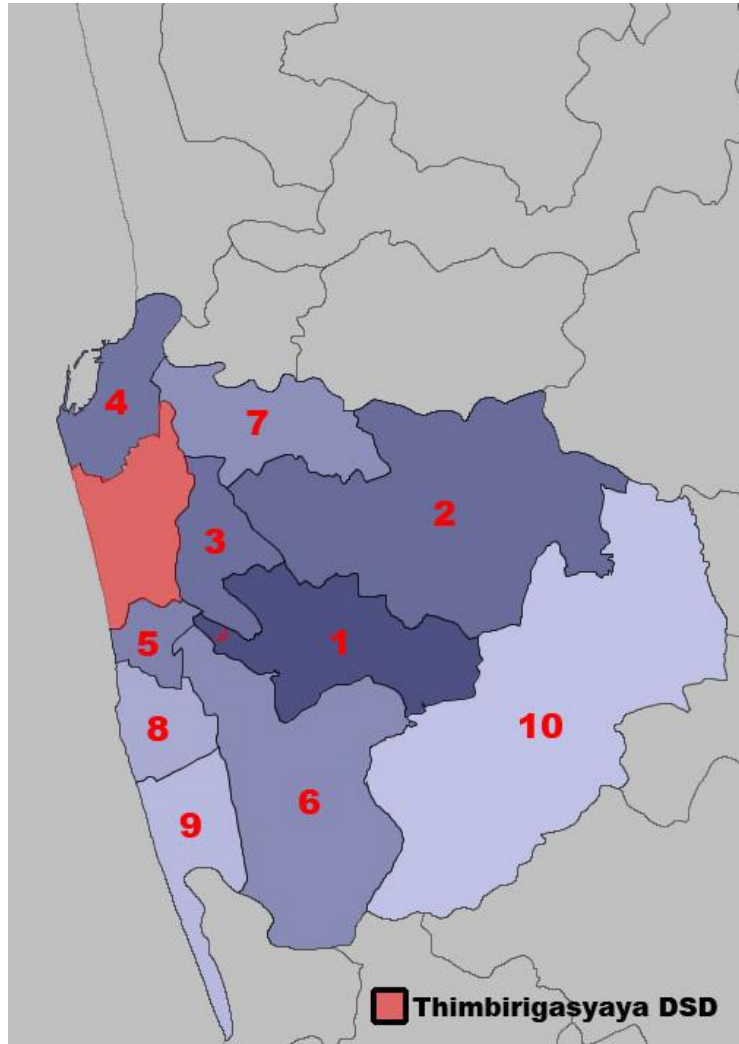
# At least 50.5% of Colombo DSD's working population comes from the surrounding regions



Home DSD	%age of Colombo's daytime population
Colombo DSD	49.5
1. Thimbirigasyaya	6.0
2. Kolonnawa	4.0
3. Wattala	3.5
4. Maharagama	2.8
5. Kaduwela	2.7
6. Kelaniya	2.7
7. Sri Jayawardanapura Kotte	1.9
8. Biyagama	1.9
9. Kesbewa	1.9
10. Ja-Ela	1.7



# At least 52.9% of Thimbirigasyaya DSD's working population comes from the surrounding



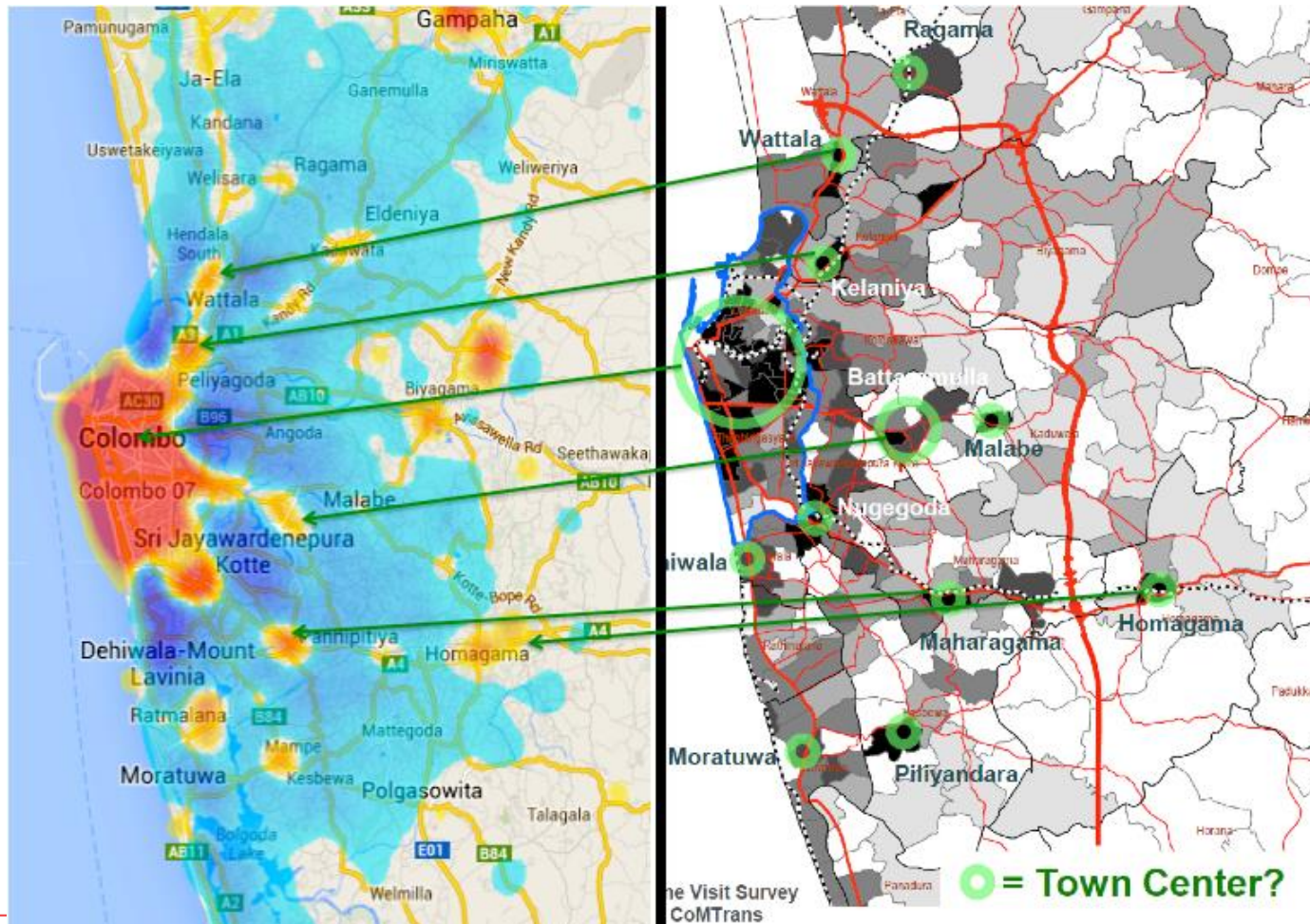
Home DSD	%age of Colombo's daytime population
Thimbirigasyaya	47.1
1. Maharagama	4.5
2. Kaduwela	3.9
3. Sri Jayawardanapura Kotte	3.8
4. Colombo DSD	3.7
5. Dehiwala	3.4
6. Kesbewa	3.2
7. Kolonnawa	3.1
8. Ratmalana	2.5
9. Moratuwa	2.2
10. Homagama	2.0

# This is a start, but further refinement required

- Adjust for different behaviors
  - People with multiple work locations
  - People with inverted shifts
  - People who do not work
- Calculate home and work locations at a smaller administrative area level
  - i.e. move from DSD (3<sup>rd</sup> level) to a GND (4<sup>th</sup> level)
- Address different travel motifs
  - Home to school and vice versa
  - Home to shopping and vice versa
  - Etc.

# Making the case for providing timely and policy relevant evidence from mobile network big data

- Our findings closely match the results from expensive & infrequent transportation surveys



# Policy implication

- Mobile network big data represents a viable source for **timely** and **policy relevant evidence** for transportation and urban planning
  - In developing economies, it is a **cheaper** alternative to the extant imperfect data sources

Thank you.