Leveraging Mobile Network Big Data for Transport Planning

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Responsible use of mobile meta-data to support public purposes

Jetwing Lagoon, Negombo

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LIRNEasia

Pro-poor. Pro-market

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IDRC | CRDI

International Development Research Centre

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Canada

UKaid

from the British people

Transport planning needs data

- Who is travelling? (*traveller profiles*)
- Where and when do people congregate?
- Where and when do people travel?
- How do people travel? (*mode of travel*)
- Why do people travel? (*motive*)
- What matters to the commuter? (*preferences*)
- How do commuters respond to changes in the transport system?

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Where and when do people congregate?

Why is it important?

- Persons staying at a location for a significant time consume resources/goods/services from there

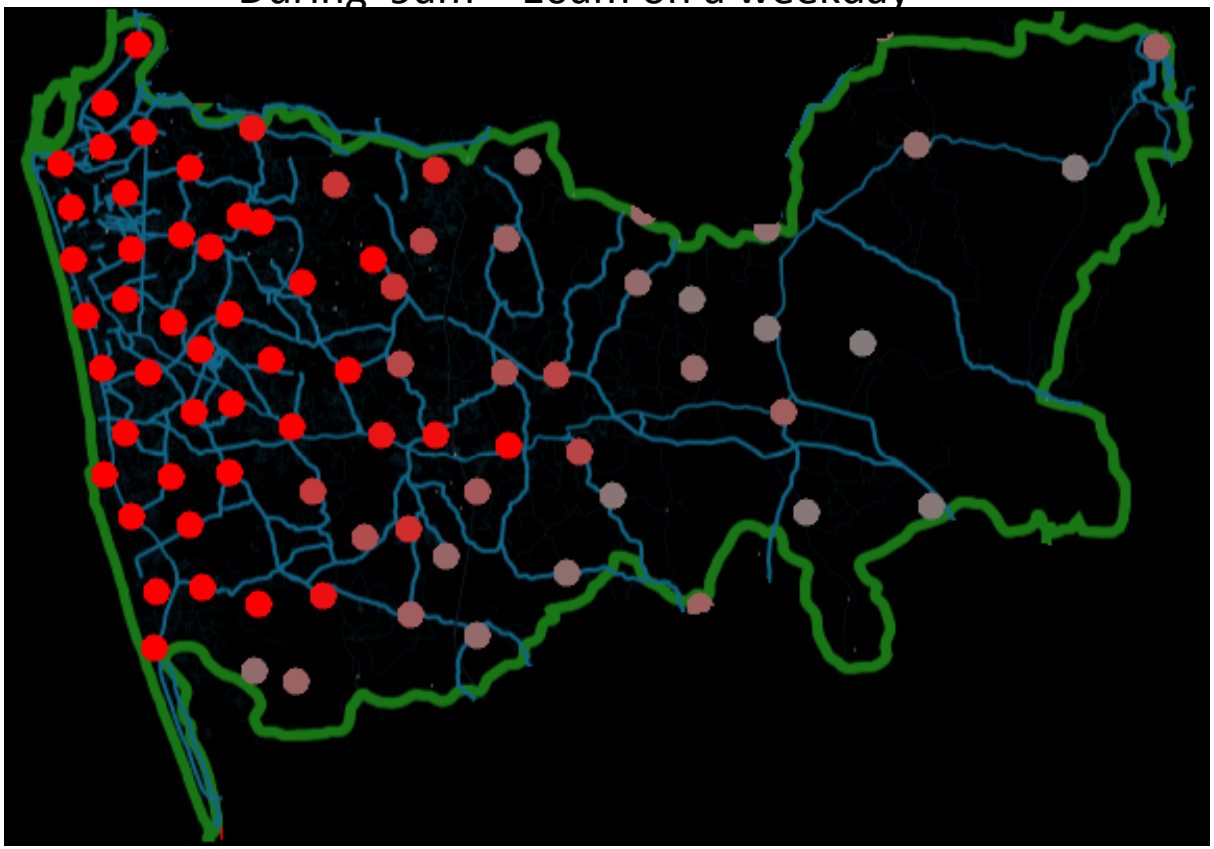
- Availability of facilities and resources must correspond to volume of people at a location at specific times
  - Knowing where people congregate is also useful for deciding locations of new service outlets

Using mobile network big data to identify congregations

- We identify where individuals have spent a minimum period with reasonable confidence (Stays)
  - A *stay* is a sequence of events for a user,
    - which include instances of voice, GPRS and SMS usage
    - within a given distance of each other (1km)
    - spanning a given minimum period of time (10 minutes)
    - with consecutive events no more than a given time apart (1 hour)
  - A stay is represented as: **(user,latitude,longitude,start,end)**
- We aggregate stays at the population level to identify Points of Interest (POI), in this case congregations

Where and when do people congregate in Colombo District?

During 9am – 10am on a weekday



Low → High

Density of People

Visualization of congregations in Colombo District over a weekday

Where and when do people travel?

Why should we care?

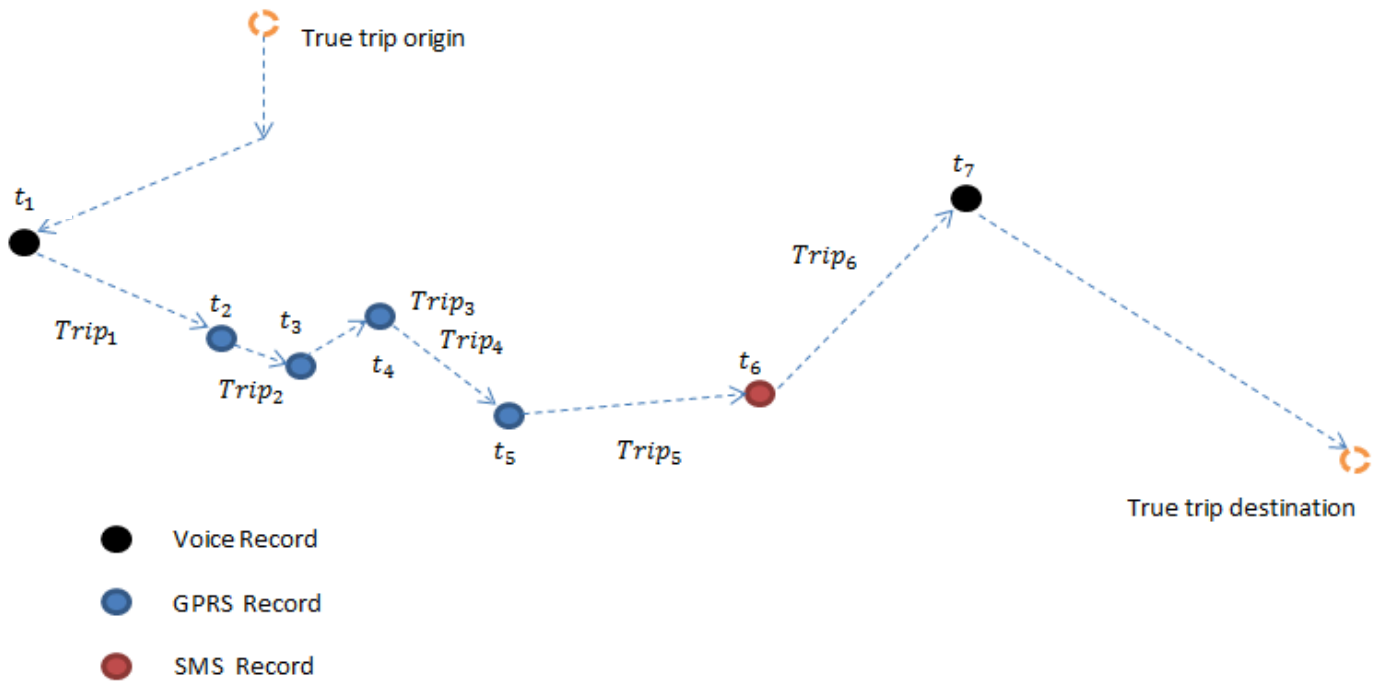
- Congestion is expensive
- Results in
  - Wasted fuel
  - Wasted time for commuters
  - Loss of productivity for businesses (delivery/ production)
- In 2011, the cost of congestion in the Western Province was approximately LKR 32 billion (USD 285 million), an average of LKR 10,000 per person per year
  - Source: Kumarage (2011)

How do we address congestion?

- Accurate prediction of where and when people travel will help in addressing congestion
- We could then,
  - Optimize movement along existing road networks
  - Optimize existing public transport routing
  - Add capacity to the transport network where needed
  - Promote new concepts like part & ride, carpooling and flexible work hours
  - Diversify land use patterns to re-distribute traffic

Modelling travel with mobile network big data...

- We identify individual "trips" by considering consecutive call/ GPRS/ SMS events with spatio-temporal constraints
  - Trips are transient, i.e they don't necessarily represent actual trips of a person, but at the very least capture segments



Identifying trips

- A ***trip*** is, a pair of consecutive events where a displacement occurs for a user which is more than 10mins and less than 1hr apart
  - This approximates actual trips
  - This also minimizes false positives where consecutive events are served by different neighbouring towers when the user is stationary
- Trips are aggregated considering base stations as origins and destinations
- Trips are aggregated daily and hourly as Origin-Destination (OD) matrices

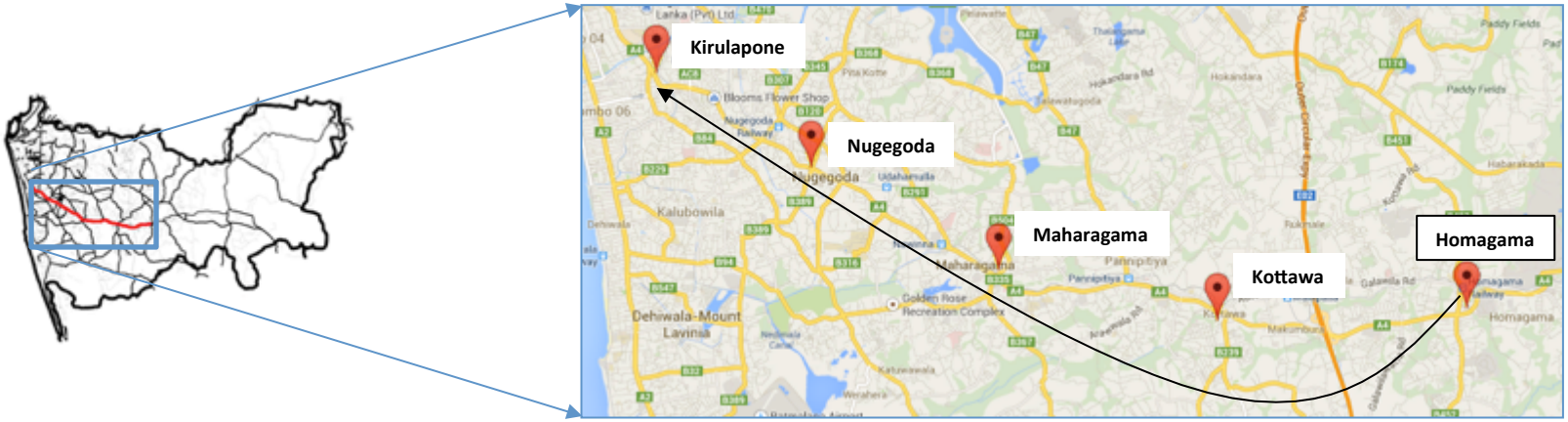
More movement towards Colombo city in the morning on normal working day along High Level Road

O-D matrix during 7am – 8am on a weekday

Destination

Source

	Kirulapone	Nugegoda	Maharagama	Kottawa	Homagama
Kirulapone		8	4	4	2
Nugegoda	25		6	4	1
Maharagama	21	29		26	10
Kottawa	11	10	70		43
Homagama	3	8	26	73	



By early afternoon, movement in both directions is quite similar

O-D matrix during 12pm -1pm on a weekday

Destination

Source

	Kirulapone	Nugegoda	Maharagama	Kottawa	Homagama
Kirulapone		33	13	4	1
Nugegoda	38		24	4	2
Maharagama	8	25		72	19
Kottawa	3	10	60		66
Homagama	1	4	13	81	

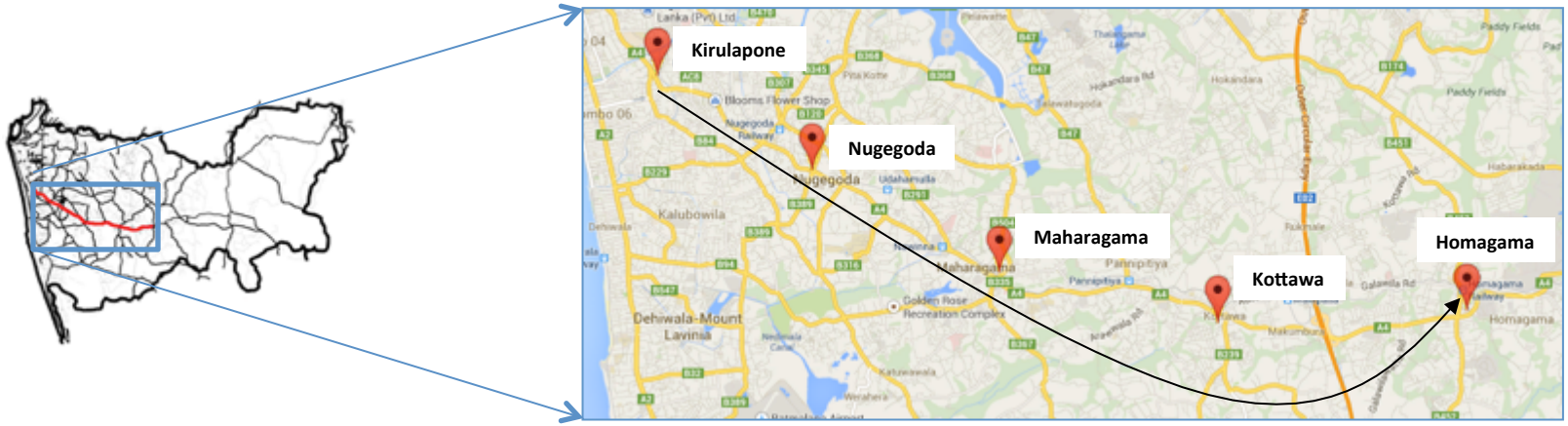
In the evening the direction changes, with more movement away from Colombo city along High Level Road

O-D matrix during 7pm – 8pm on a weekday

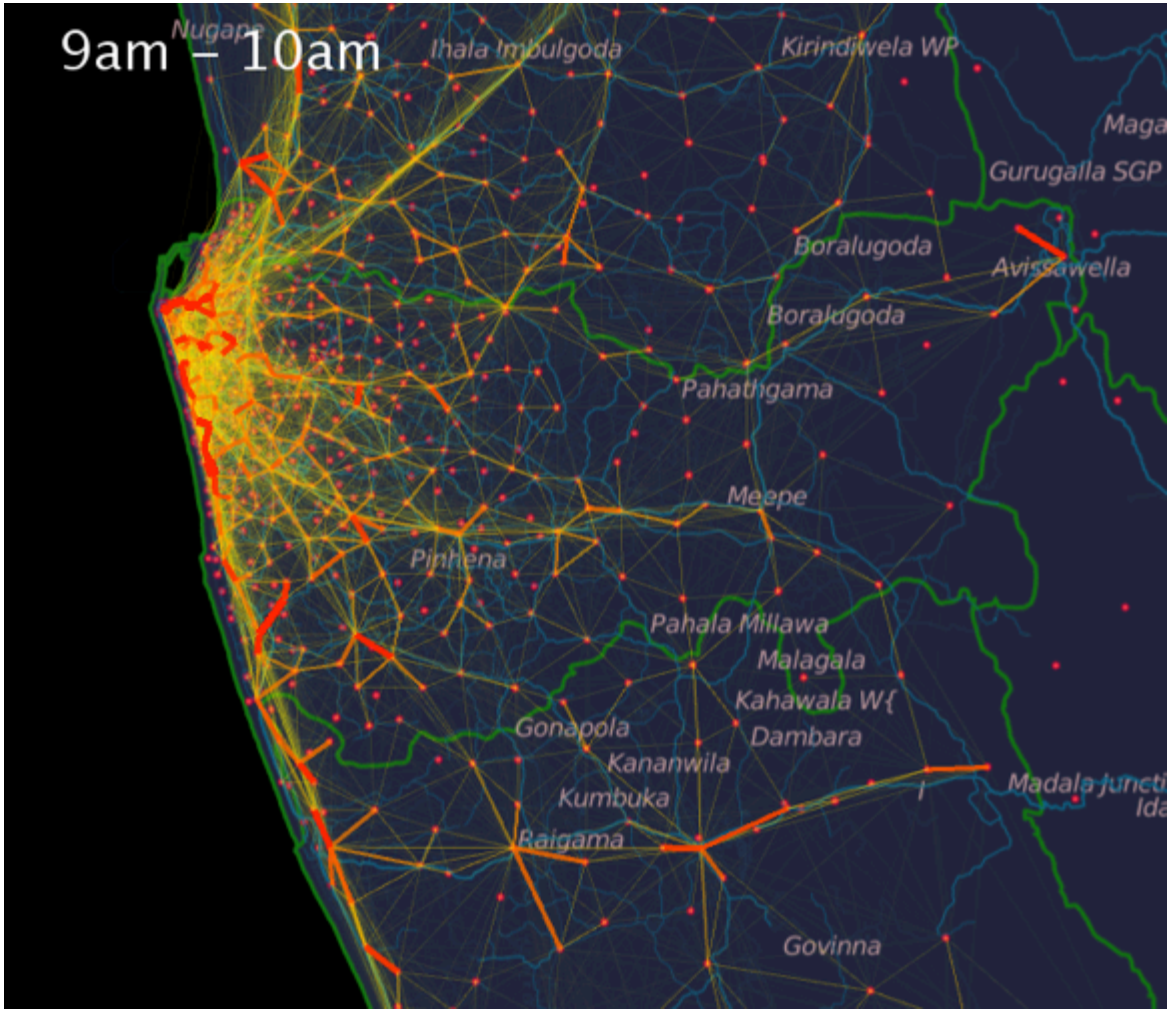
Destination

Source

	Kirulapone	Nugegoda	Maharagama	Kottawa	Homagama
Kirulapone		46	28	22	1
Nugegoda	19		63	25	10
Maharagama	4	14		168	48
Kottawa	1	2	46		142
Homagama	4	0	23	60	



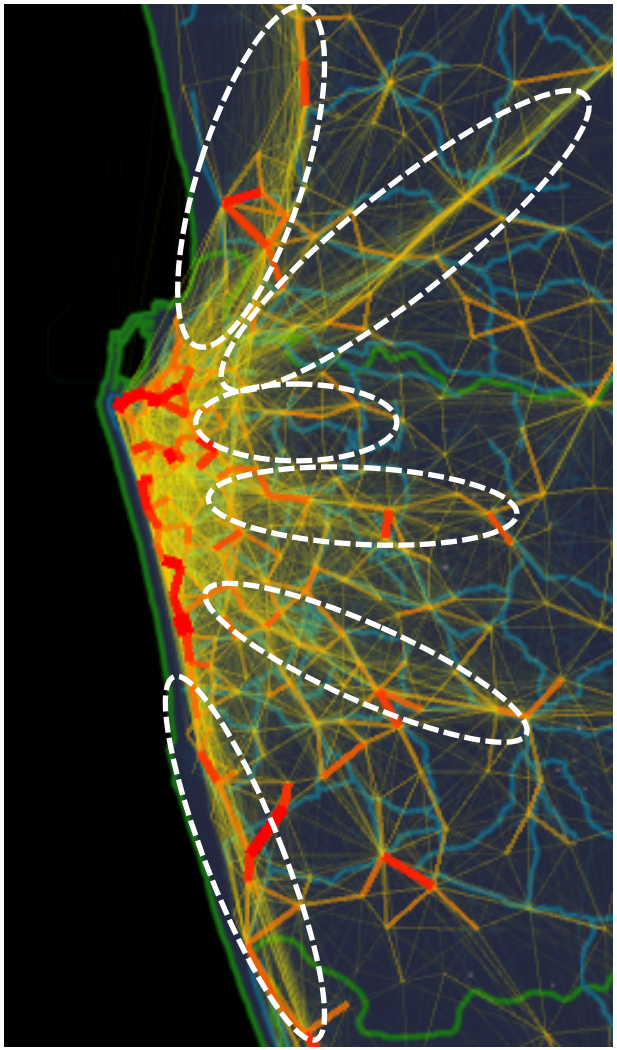
Visualizing movement in Colombo District on a weekday morning



Low → High

Volume of People

Mobility visualization for Colombo District identifies transport corridors



Low → High

Volume of People

Source: COMTRANS report,2013, Ministry of Transport

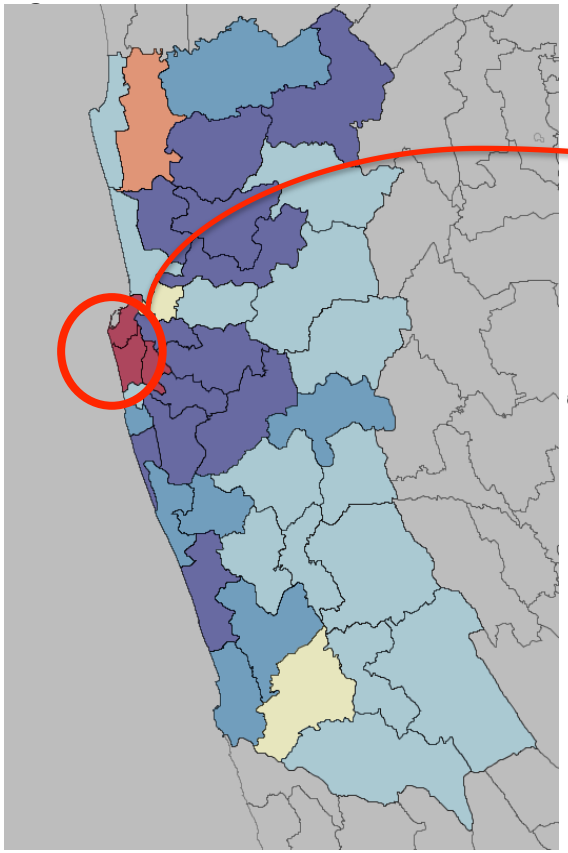
Mobility visualization of Western Province on a weekday

DSD level mobility in Western Province

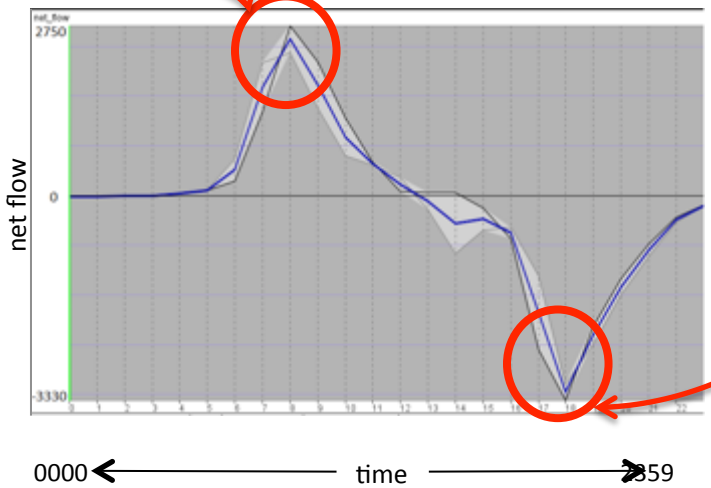
- Net flow of people into/(out of) a DSD during a weekday
  - *Net flow = Inflow of people - Outflow of people*
- Results consistent with generally accepted patterns of movement of people within the Western Province

Colombo city has large morning inflows, which reverses in the evening .....

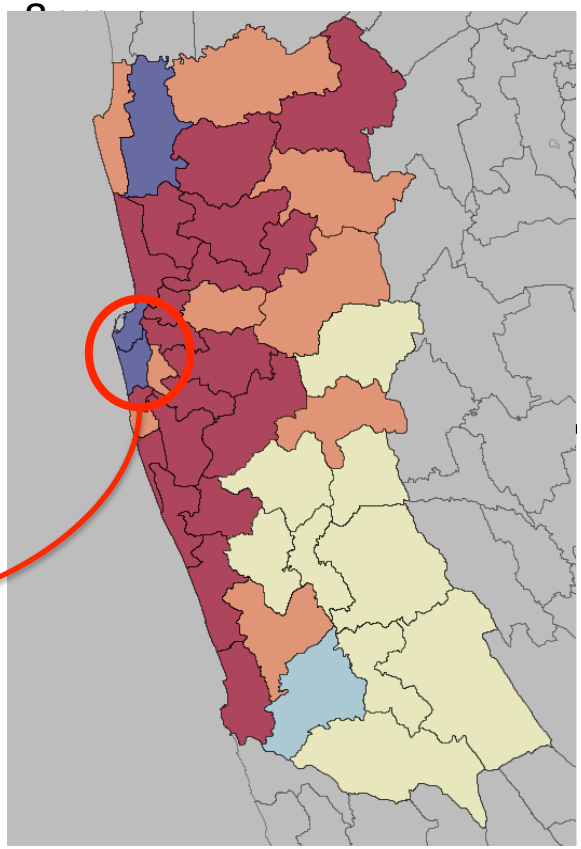
Net flow during 8am -

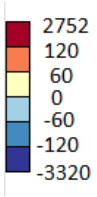


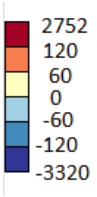
Net flow over 24 hours



Net flow during 7pm -

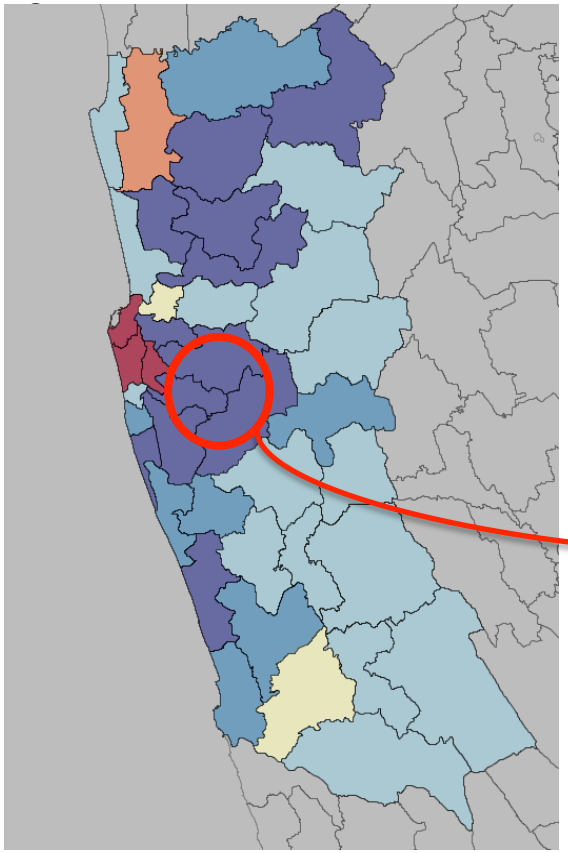


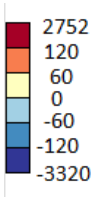




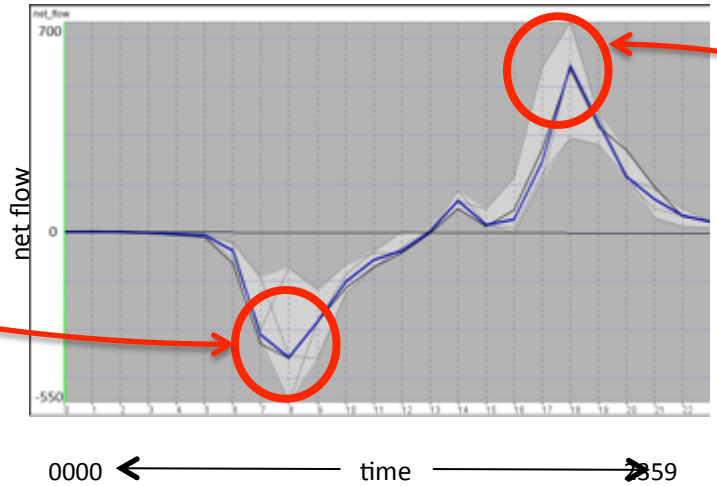
….. While outlying areas have outflows in the morning, which reverse in the evening

Net flow during 8am -





Net flow over 24 hours



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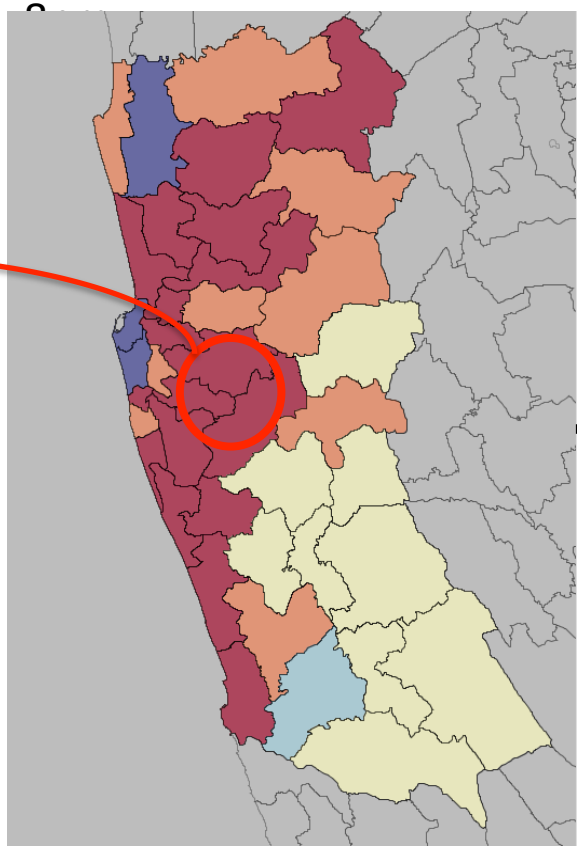

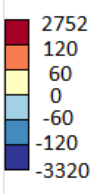

Next steps

- Linking human mobility findings with the traditional transport planning methodology

- Transforming mobility findings into measurements of congestion
  - Assigning trips to the existing road network
  - Estimating travel speeds

- Agent based simulation of aggregate transport demand in urban areas.