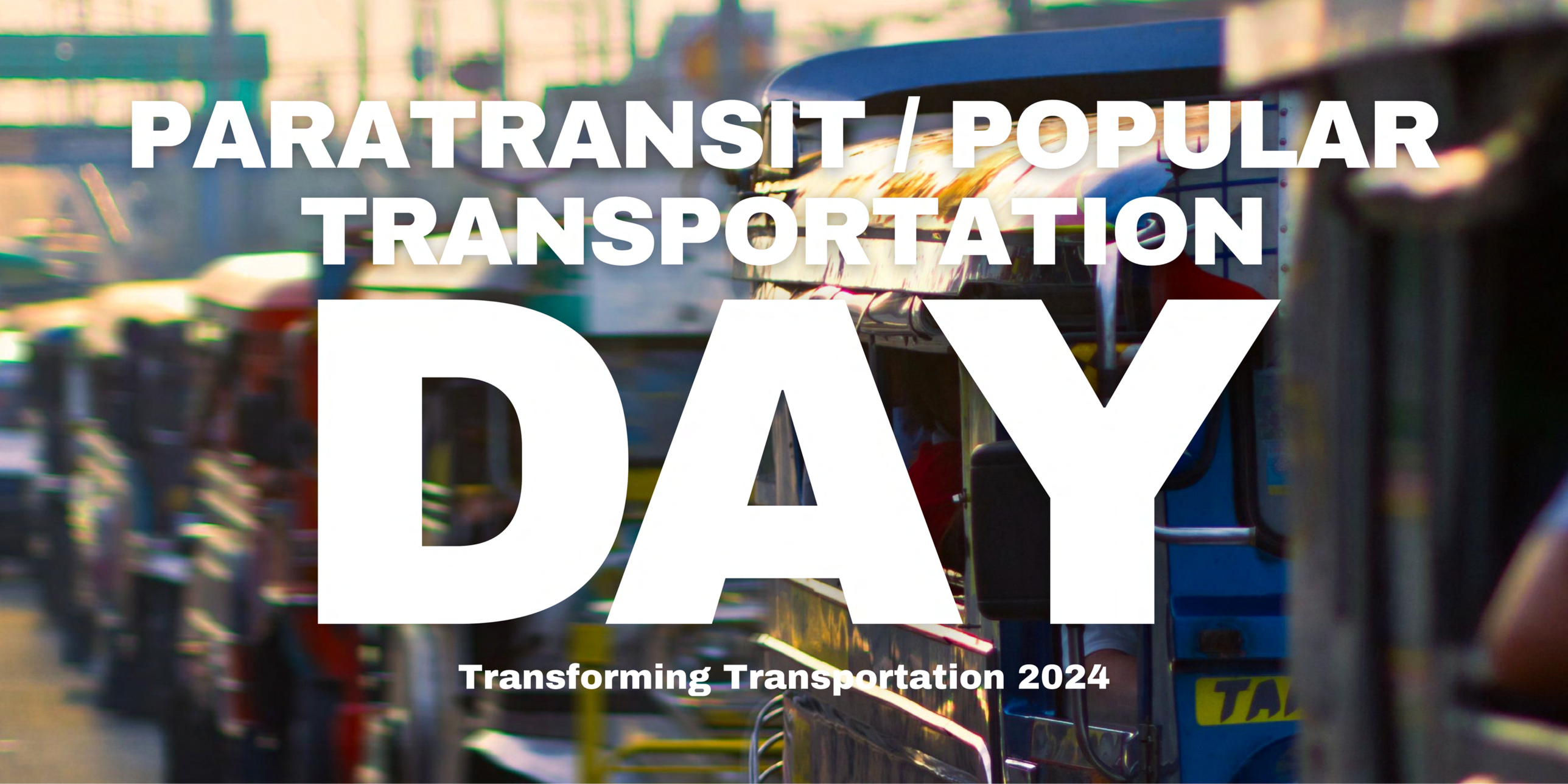

PARATRANSIT / POPULAR
TRANSPORTATION
DAY
Transforming Transportation 2024

SESSION THREE:

Expanding Data and Tech for Finance and Climate in Popular Transportation

Paratransit / Popular Transportation Day
at Transforming Transportation 2024

Thursday, March 21, 2024

SESSION THREE | Paratransit / Popular Transportation Day:
Expanding Data and Tech for Finance and Climate in Popular Transportation

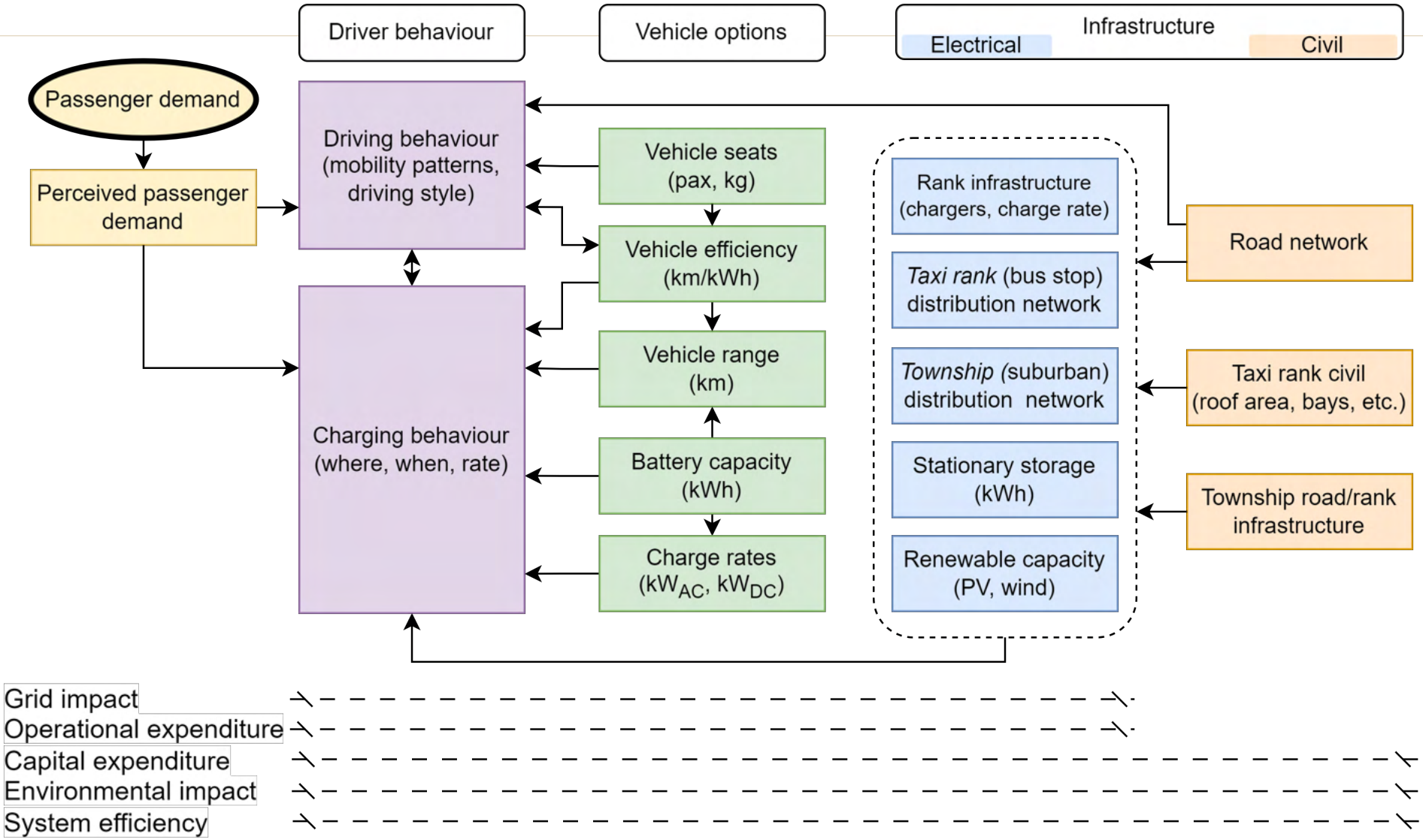
Data and Planning for the Eventual Electrification of Sub-Saharan Africa's Popular Transport

Thinus Booysen

Professor in Engineering and Research Chair in the Internet of Things,
Director of the MTN Mobile Intelligence Lab at Stellenbosch University

Thursday, March 21, 2024 | World Bank Headquarters, Washington D.C.

Aspects to consider in electric mobility



Planning and data for decarbonization

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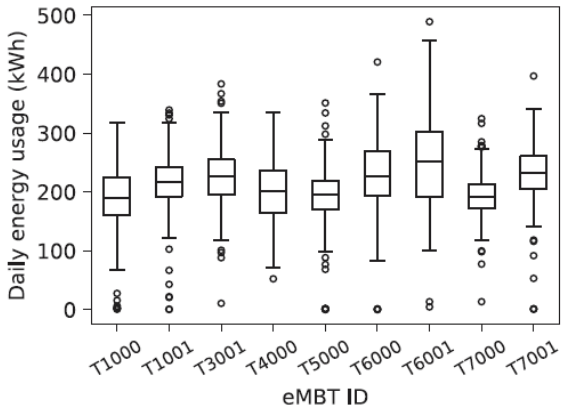
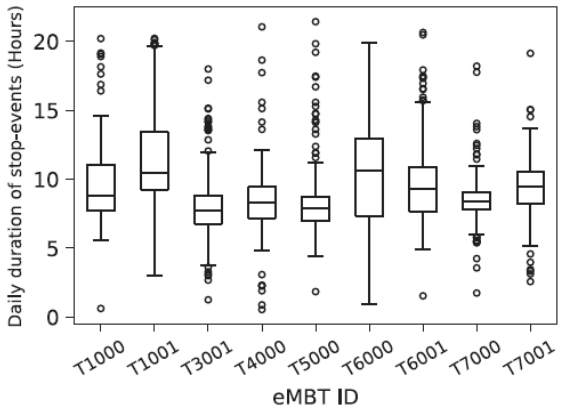
- ‘‘In light of the climate crisis, transport systems globally need to be decarbonized. This is particularly challenging in Sub-Saharan Africa (SSA) where transport systems are poorly characterized due to **a lack of data**, which contributes to hindering investment. We call for a more systematic approach to data collection to support the sustainable transition to electric vehicles in SSA.’’—Collett and Hirmer (2021) in Nature Sustainability.

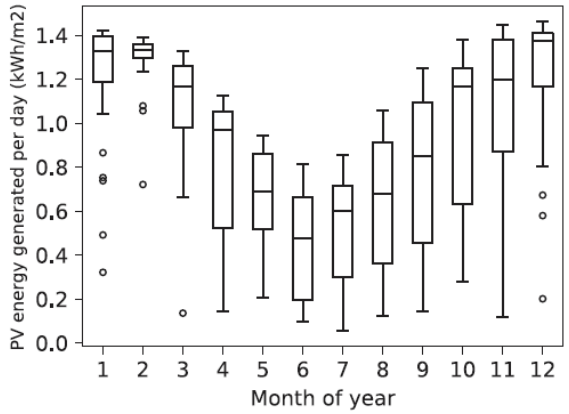
Paratransit – electrification, the vehicle



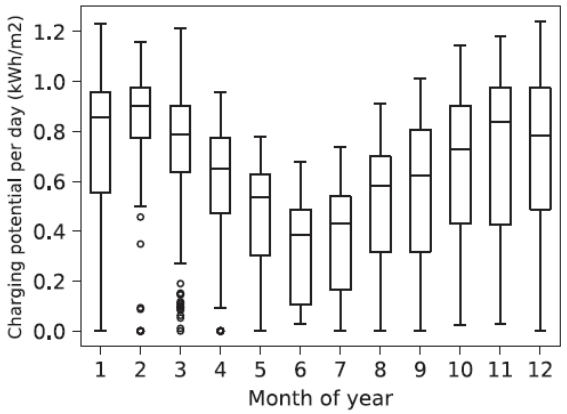
(a) Energy used per eMBT.



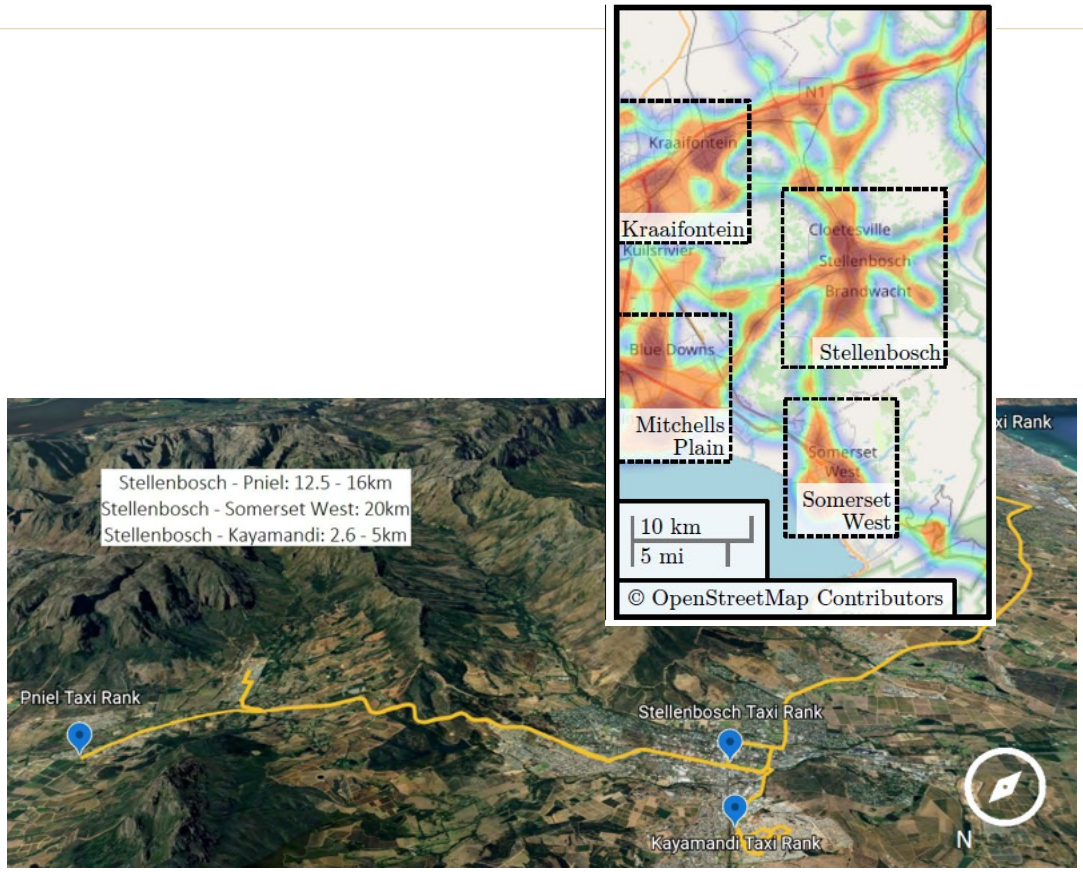
(b) Durations of stop events per eMBT.



(c) PV generation per m^2 per month.



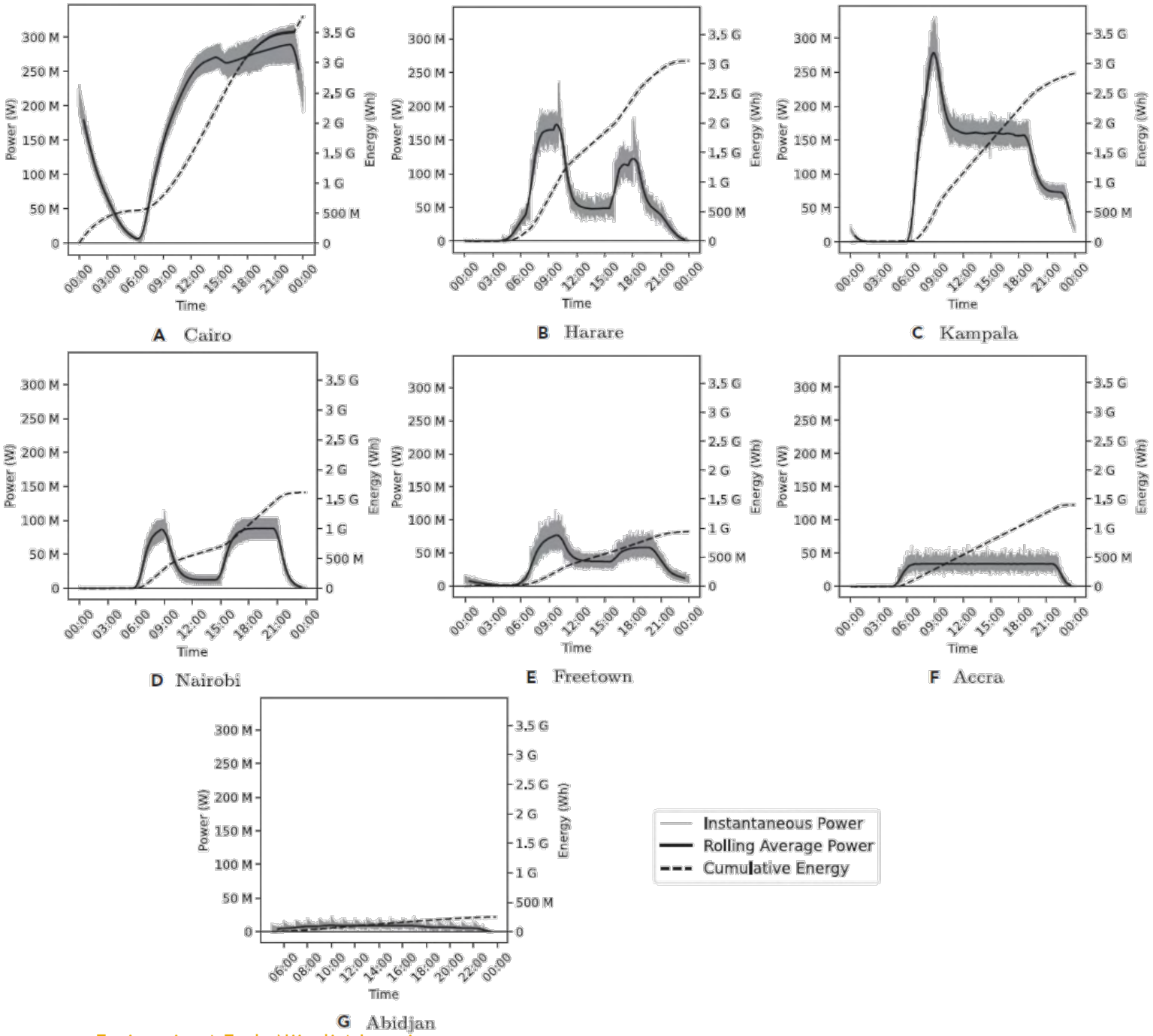
(d) PV charging potential per eMBT per m^2 per month.



Simulation and virtualization

Mobility data

- Different perspectives
  - Route-centric – transport/civil engineering planner
  - Driver-centric – operations planning
  - Vehicle-centric – required for electrification planning
- Different methods of data capture/store
  - GPS traces
    - Minutely (1/min) vs. secondly (1Hz)
    - Tracker or OBD2 port
  - Origin/destination data
  - Standardised passengers
- Different information
  - timestamp, geolocation, speed, heading, driver information, vehicle information



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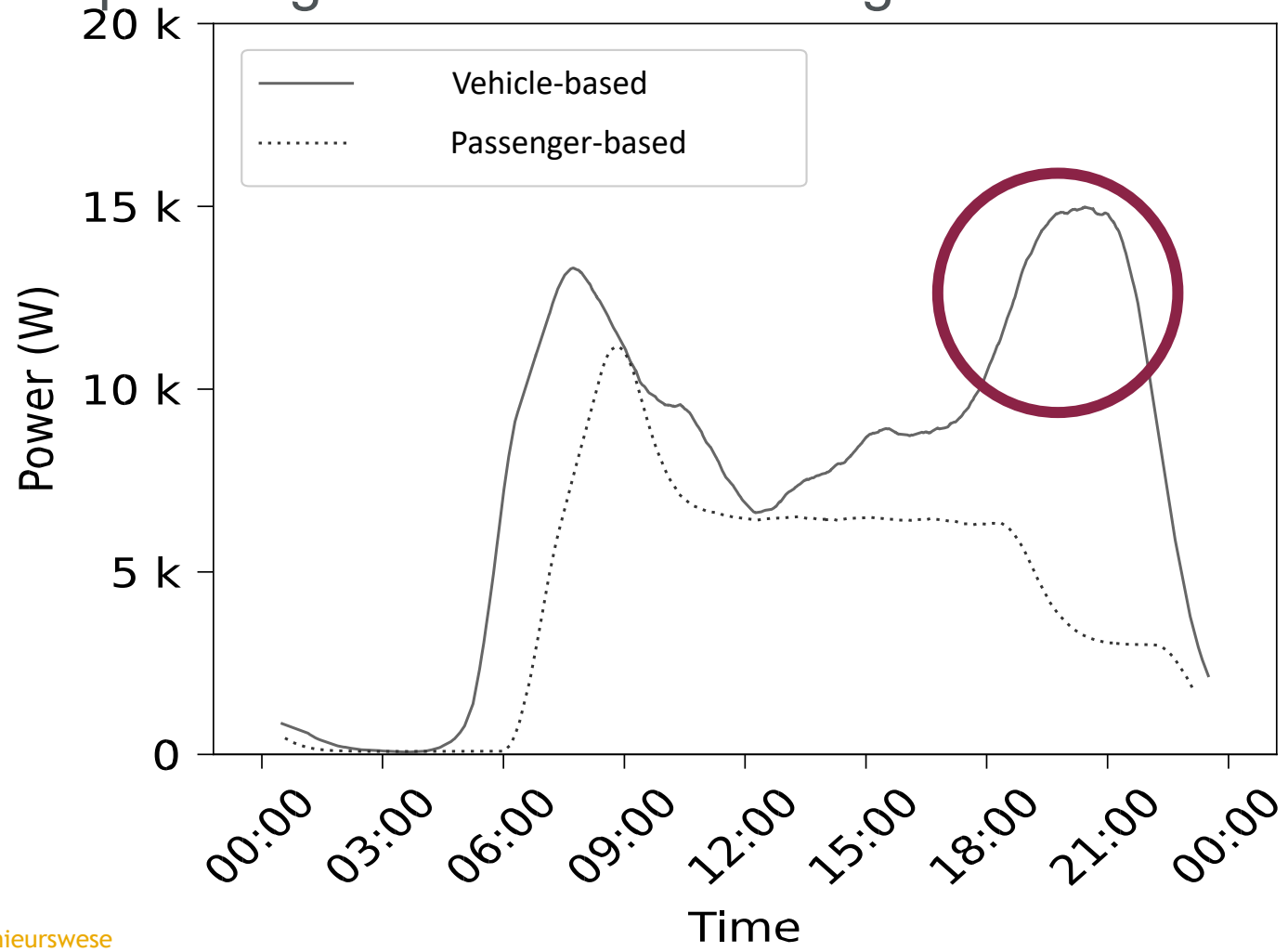
"Why taxi tracking trumps tracking passengers with apps in planning for the electrification of Africa's paratransit", iScience, 2022

doi.org/10.1016/j.isci.2022.104943

Simulation and virtualization

Mobility data

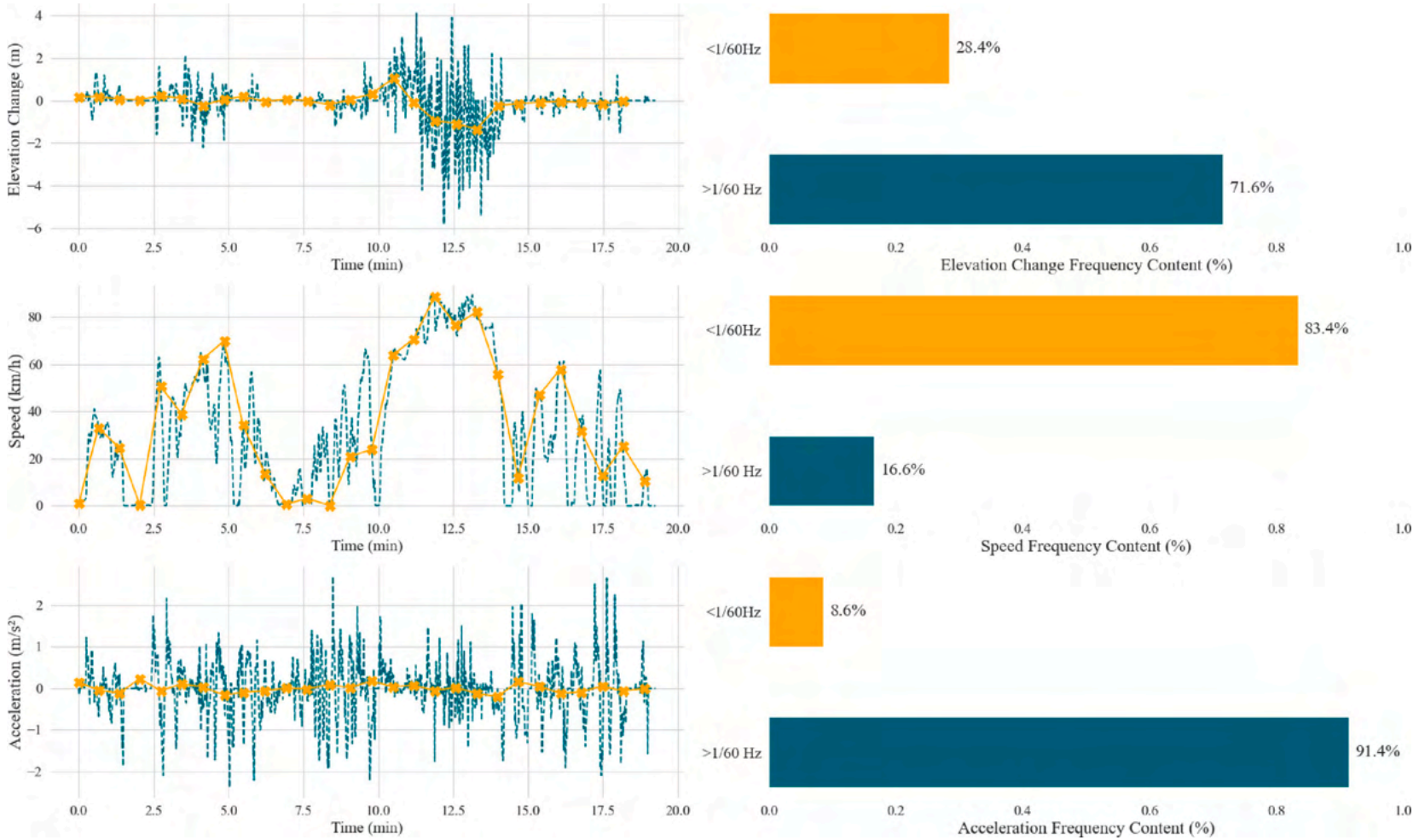
- Standardized passenger vs. vehicle tracking



Simulation and virtualization

Mobility data

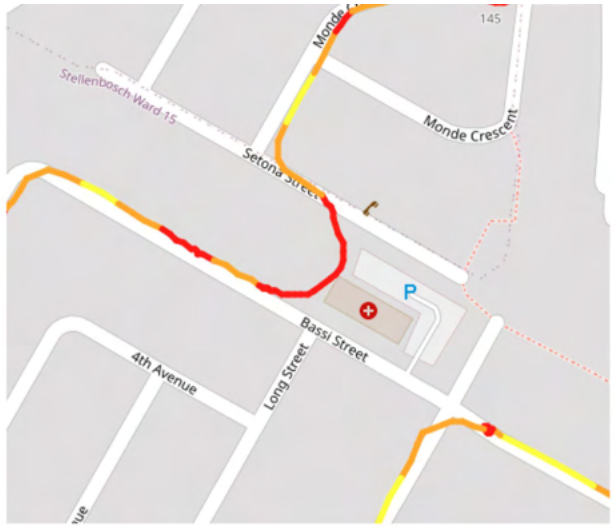
- 1Hz vs 1 min data



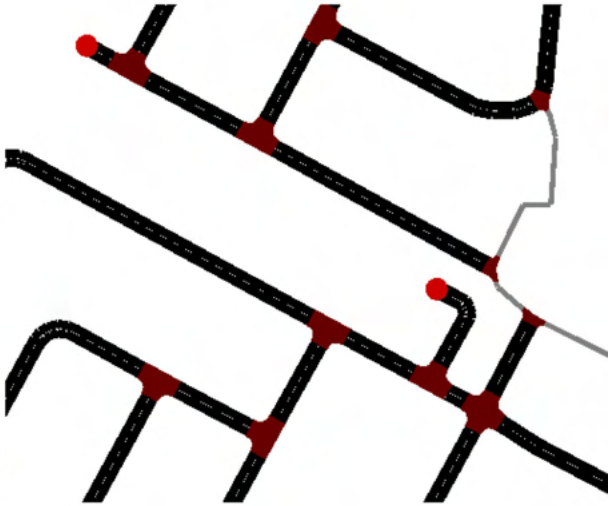
Simulation and virtualization

Virtual maps

Maps mispatch to road
Drivers don’t stick to roads



(a) Actual route taken from Bassi to Setona Street



(b) Road network file of Bassi and Setona Street

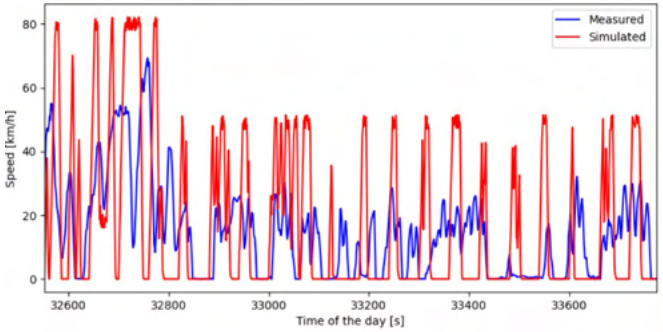
(c) As seen from Bassi Road

(d) As seen from Setona Street

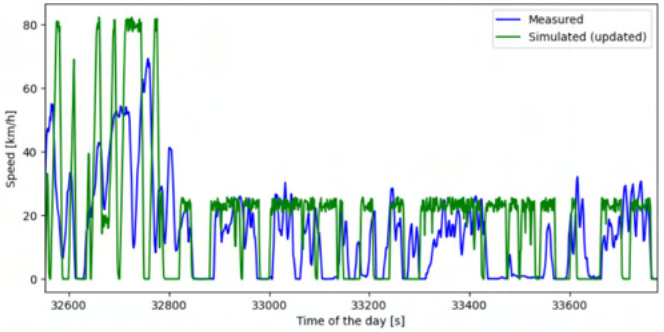
Simulation and virtualization

Virtual drivers

- Acceleration (departures, breaking)
- Speed
- Stop adherence



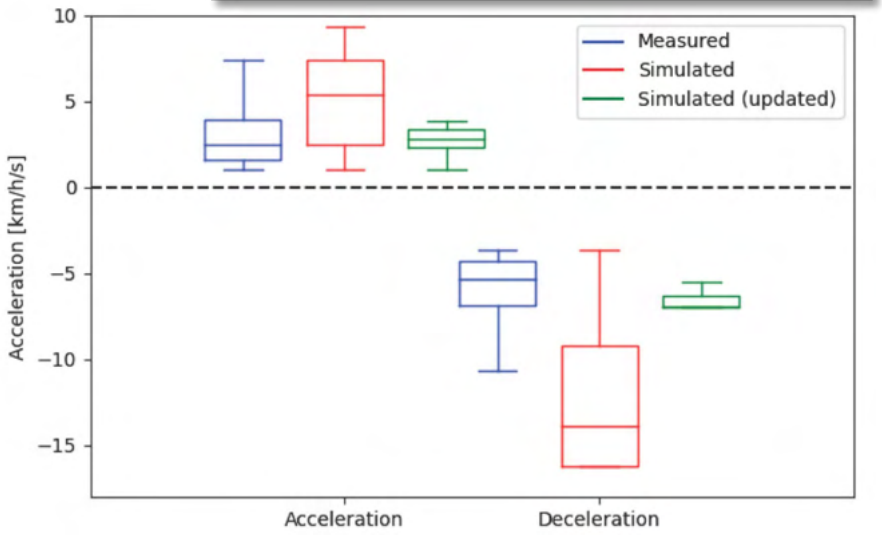
(a) Urban Route 1 before improvement



(b) Urban Route 1 after improvement

Aspect	Consumption if uncorrected [kWh/km] (% error)
Driver acceleration	0.64 (+21 %)
Elevation	0.54 (+2 %)
Legal speed limits	0.52 (−2 %)
Residential driver speed profile	0.52 (−2 %)

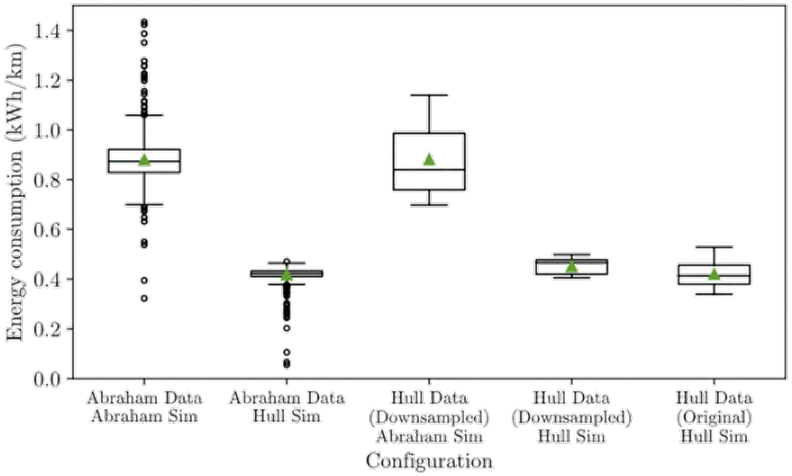
Route	Stop signs encountered	Vehicle stopped[a, b]	Stop sign ratio (%)
Urban 1	64	17	26.6
Urban 2	12	4	33.3
Inter-city 1	36	13	36.1
Inter-city 2	21	6	28.6
Uphill	63	19	30.2
Downhill	49	13	26.5
Total	245	72	29.4



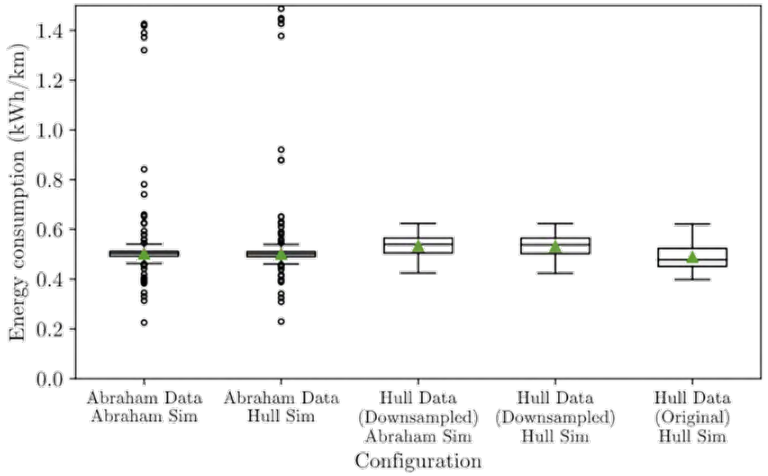
Simulation and virtualization

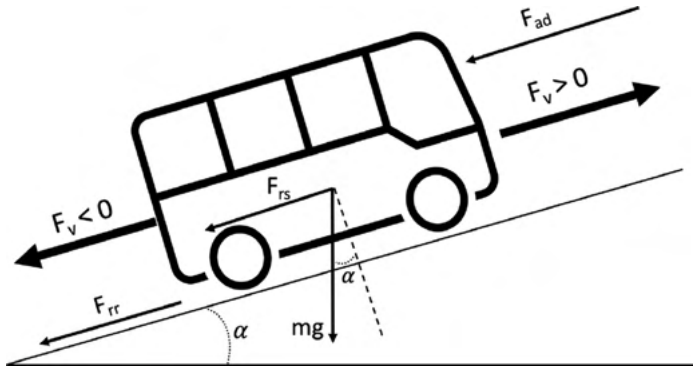
Electro-kinetic model

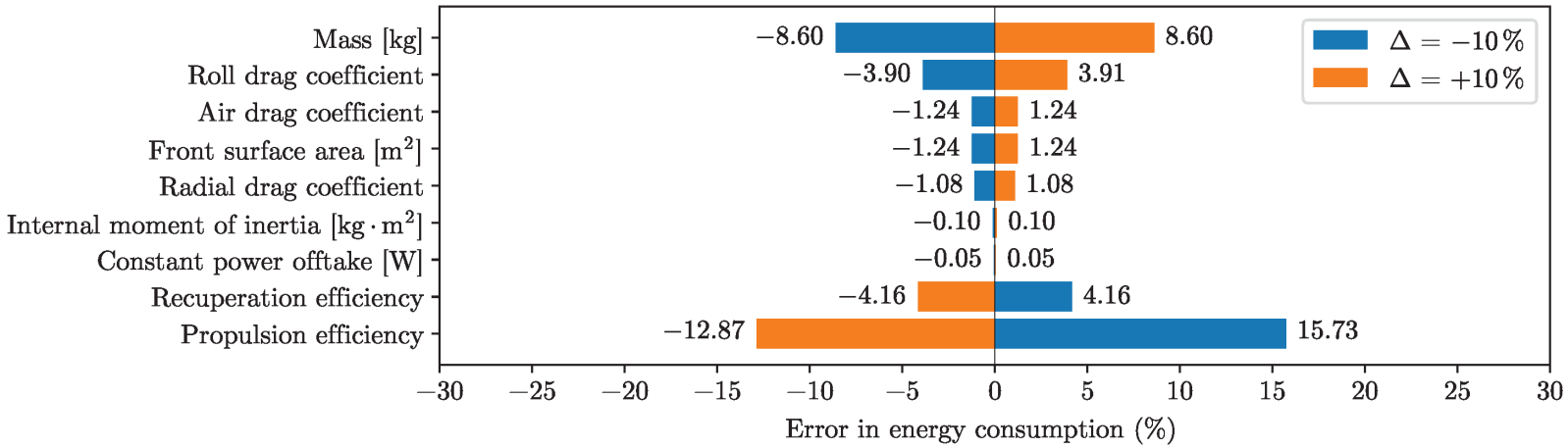
Original models



Aligned models



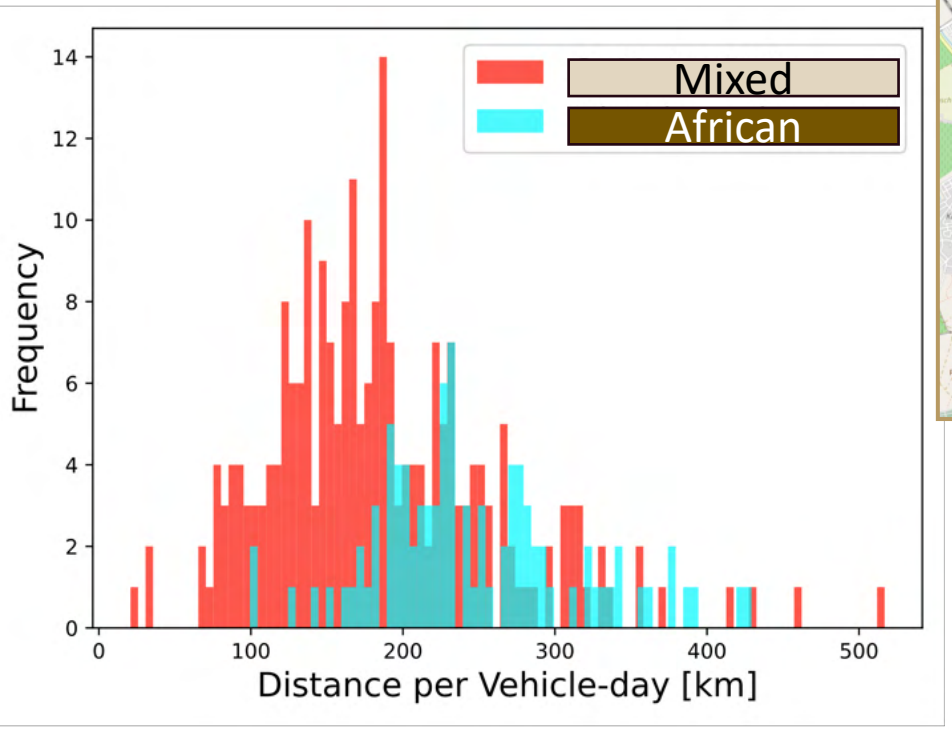




Main publications:

C.J. Abraham, A.J. Rix, M.J. Booysen, "Aligned simulation models for simulating Africa's electric minibus taxis", *under review.*

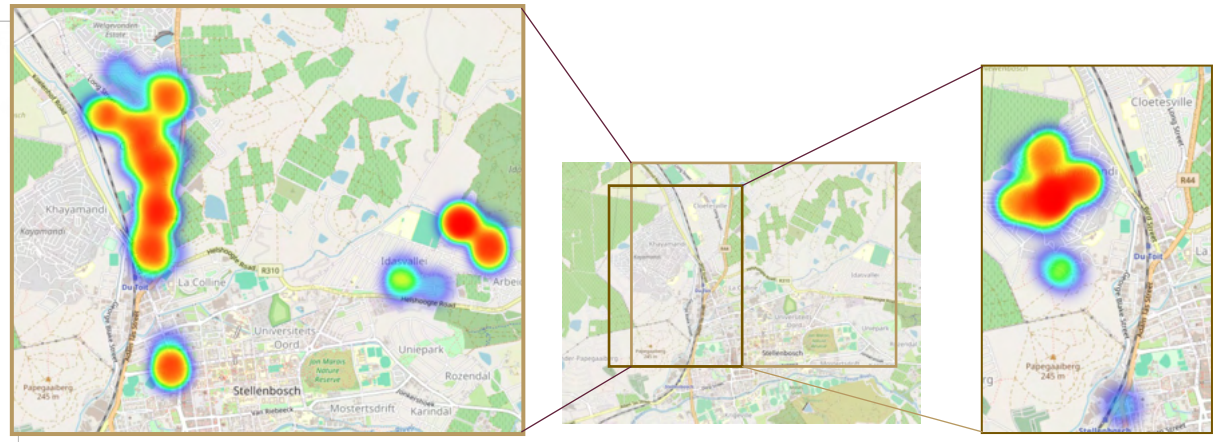
Data representativeness



Overnight areas

Mixed

African



Overall			
	Mixed	African	Totals
Intra-city	204 (86%)	17 (19%)	221 (67%)
Inter-city	32 (14%)	75 (81%)	107 (33%)
Totals	236 (72%)	92 (28%)	328

Data representativeness

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Depot charging

Overall Vehicle-day Success Rate					
	Overall	Coloured	African	Intra	Inter
Total	328	236	92	221	107
Positive Steady State	125 (38%)	121 (51%)	4 (4%)	115 (52%)	10 (9%)
Zero Steady State - Battery	91 (28%)	37 (16%)	54 (59%)	38 (17%)	53 (50%)
Zero Steady State - Charging	112 (34%)	78 (33%)	34 (37%)	68 (31%)	44 (41%)

Depot + home charging

Overall Vehicle-day Success Rate					
	Overall	Coloured	African	Intra	Inter
Total	328	236	92	221	107
Positive Steady State	227 (69%)	193 (82%)	34 (37%)	178 (81%)	49 (46%)
Zero Steady State - Battery	82 (25%)	35 (15%)	47 (51%)	32 (14%)	50 (47%)
Zero Steady State - Charging	19 (6%)	8 (3%)	11 (12%)	11 (5%)	8 (7%)

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Most relevant publications:

Why taxi tracking trumps tracking passengers with apps in planning for the electrification of Africa's Paratransit
https://doi.org/10.1016/j.isci.2022.104943

Aligned Simulation Models for Simulating Africa's Electric Minibus Taxis

https://doi.org/10.3390/wevj14080230

High fidelity estimates of paratransit energy consumption from per-second GPS tracking data

https://doi.org/10.1016/j.trd.2023.103695

Grid and mobility interdependence in the eventual electrification of operational minibus taxis in cities in sub-Saharan Africa

https://doi.org/10.1016/j.esd.2024.101411

PARATRANSIT / POPULAR TRANSPORTATION DAY 2024

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UNFCCC Climate Champions (CCT)
Digital Transportation for Africa (DT4A)
Global Network for Popular Transportation (GNPT)
International Transport Forum (ITF)
International Transport Workers Federation (ITWF)
Shared-Use Mobility Center (SUMC)
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