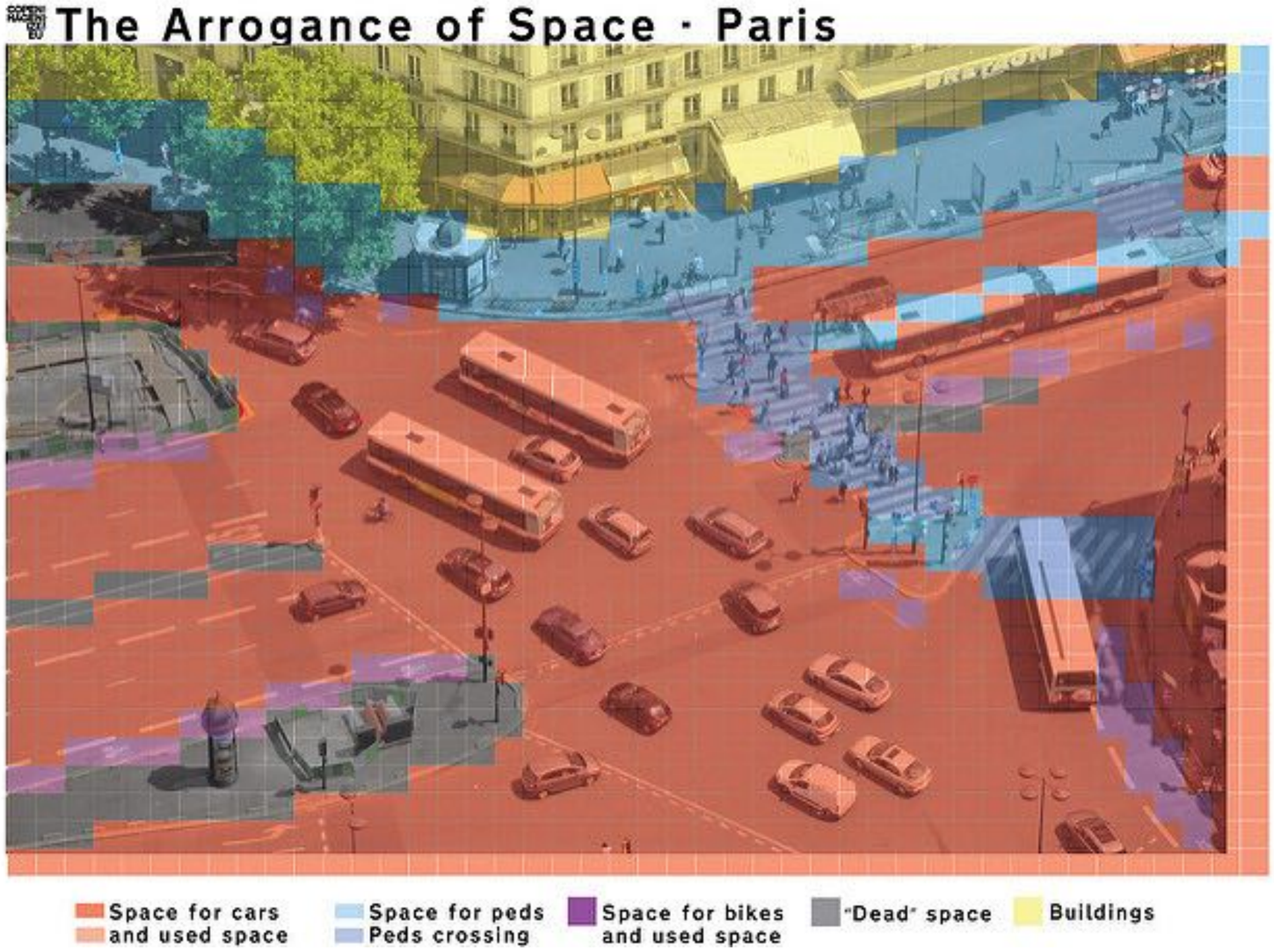
# Human-centric Urban Data Science with OpenStreetMap

Michael Szell

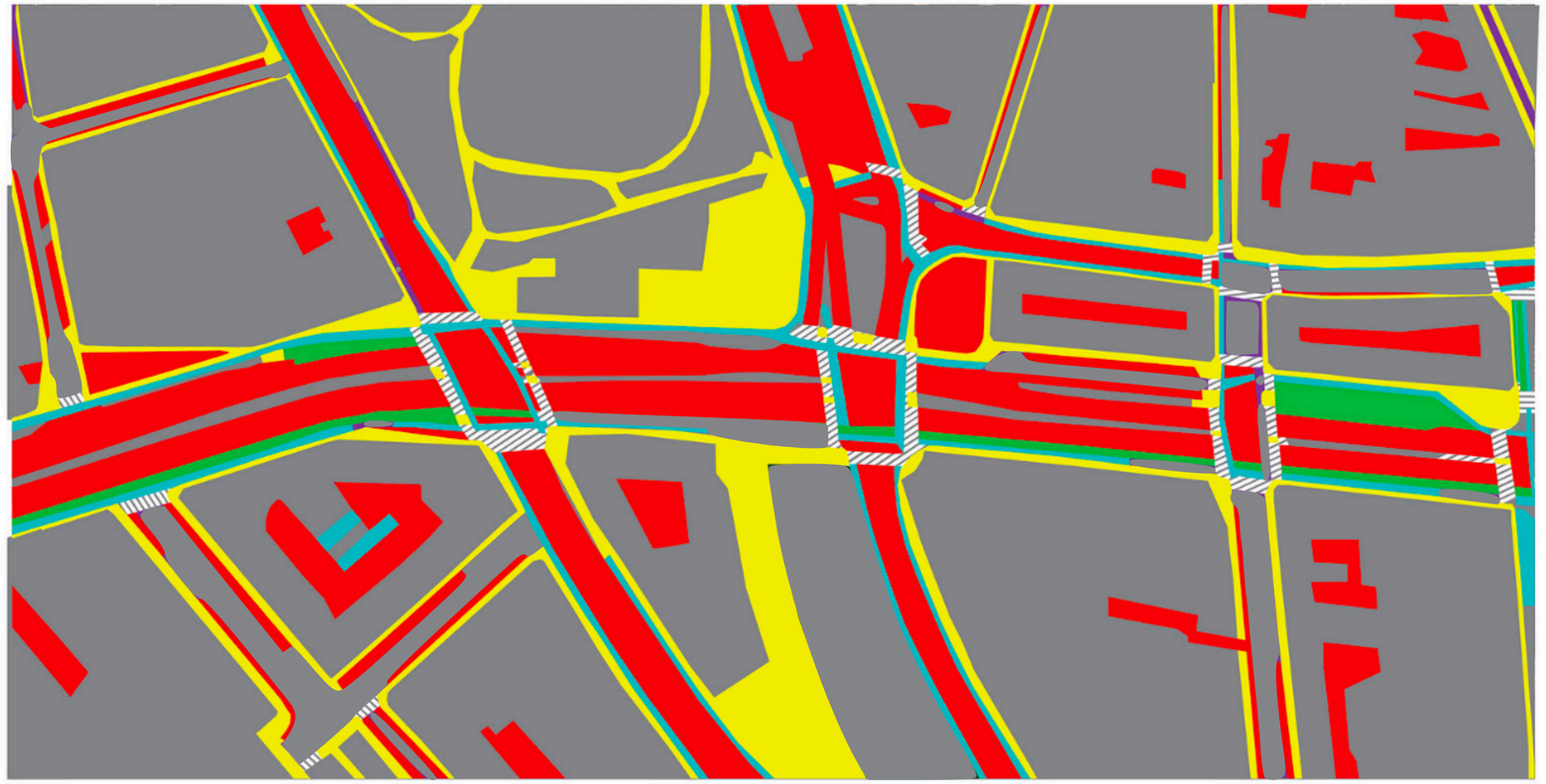
Sep 23, 2020
MIT Media Lab

IT UNIVERSITY OF COPENHAGEN

# Space is not distributed in a fair way between different modes of transport



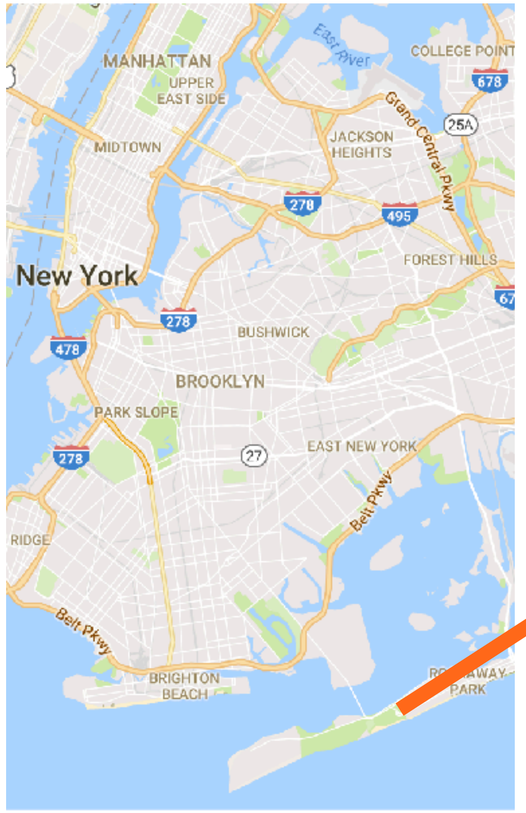
# Most space is for cars, but most people use bikes



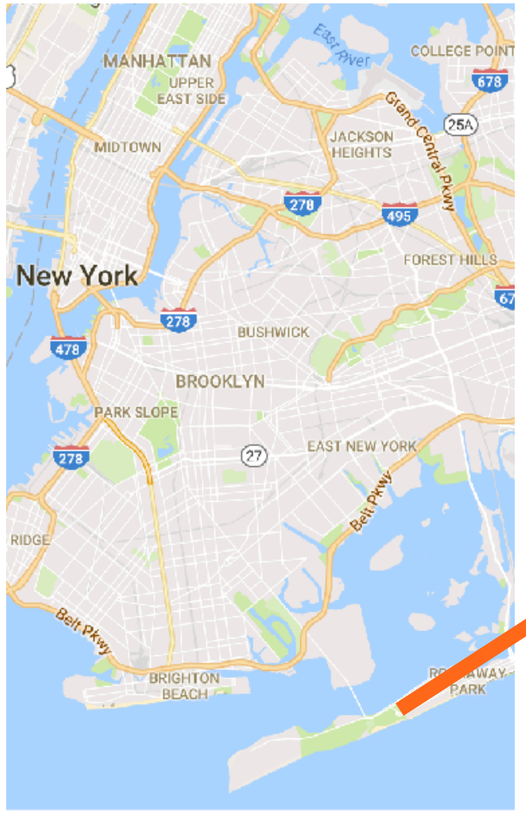

Copenhagenize

Gossling, Schroder, Spath and Freytag, Transport Reviews 36, 659-679 (2016)

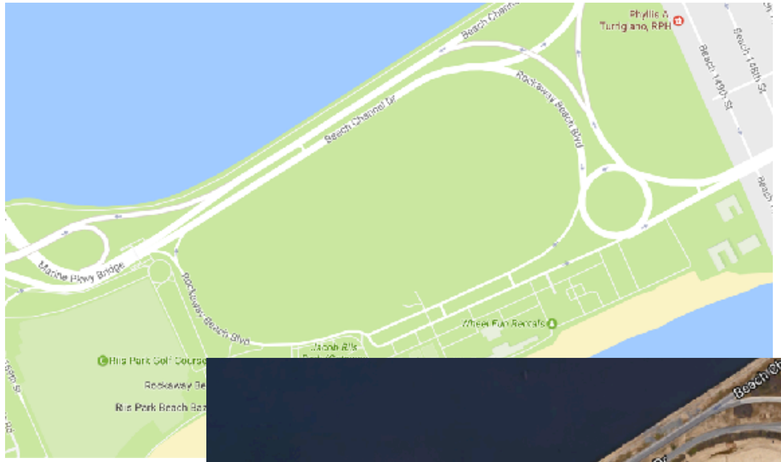
Can we use data science and visualization to learn more?



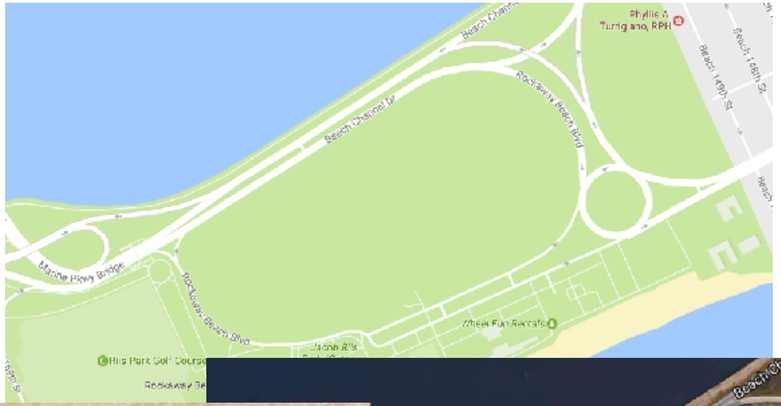

# What a lovely green..

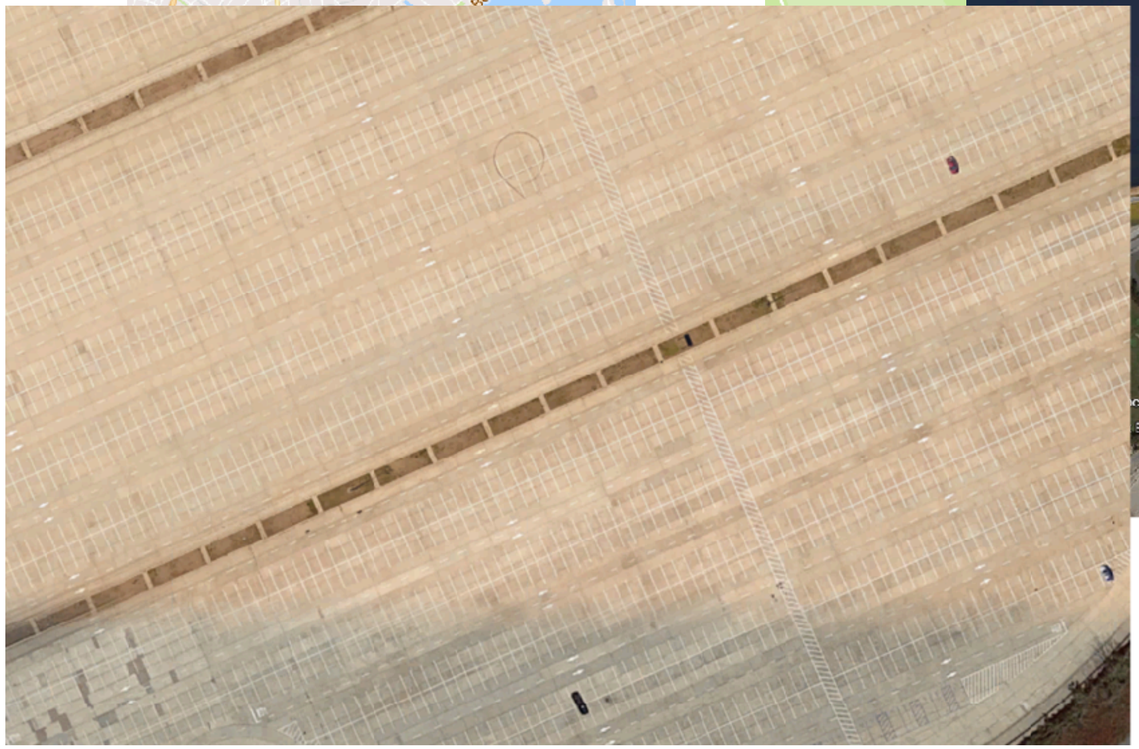


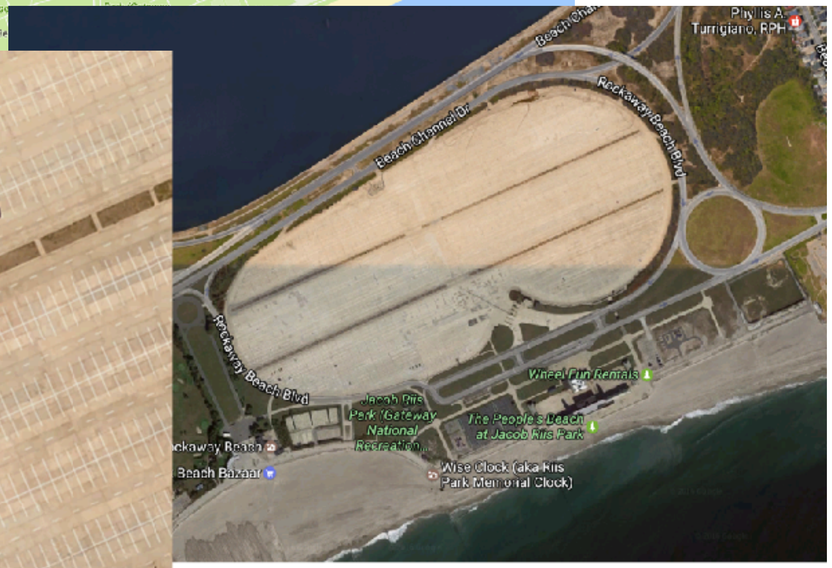

# What a lovely ~~green~~..




# What a ~~lovely~~ ~~green~~.. MONSTER

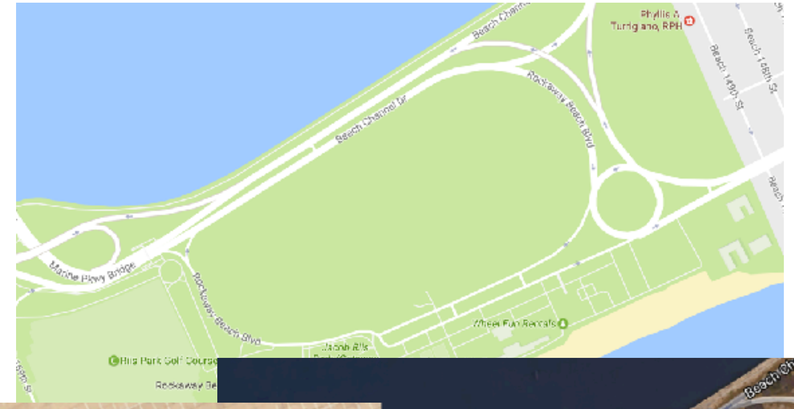



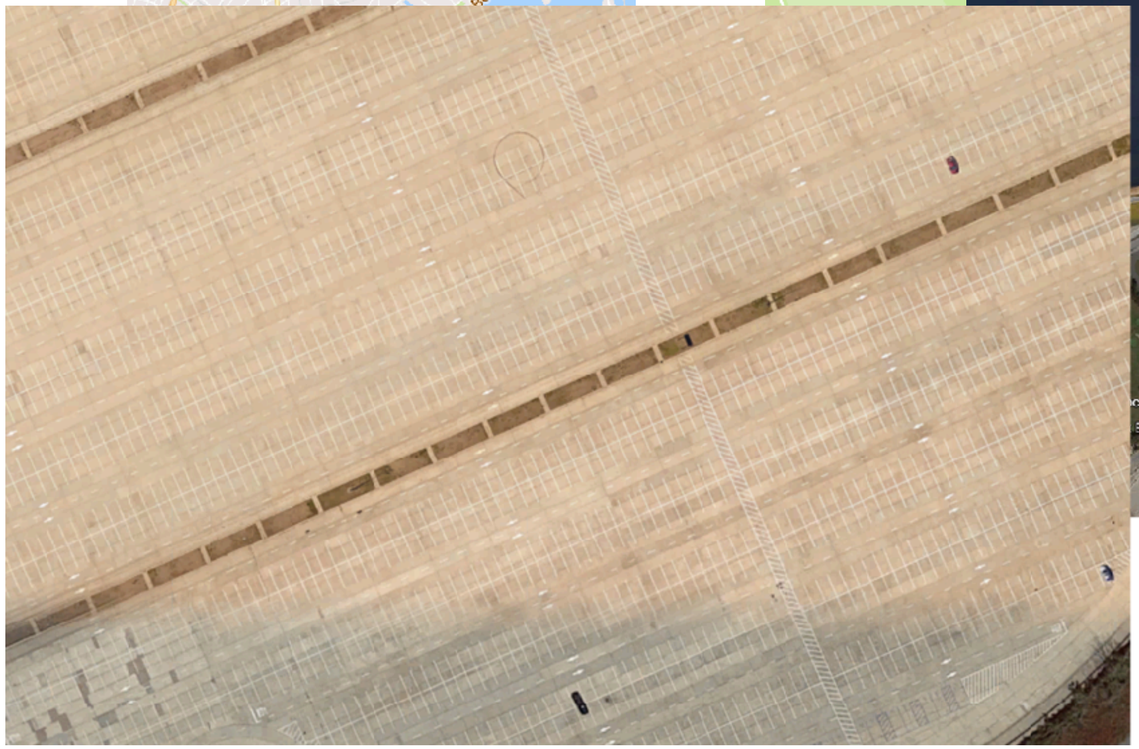






800m x 500m


MANHATTAN
UPPER EAST SIDE
MIDTOWN
JACKSON HEIGHTS
COLLEGE POINT
East River
Grand Central Pkwy
New York
FOREST HILLS
BUSHWICK
BROOKLYN
PARK SLOPE
EAST NEW YORK
Belt Pkwy
678
25A
278
495
478
27

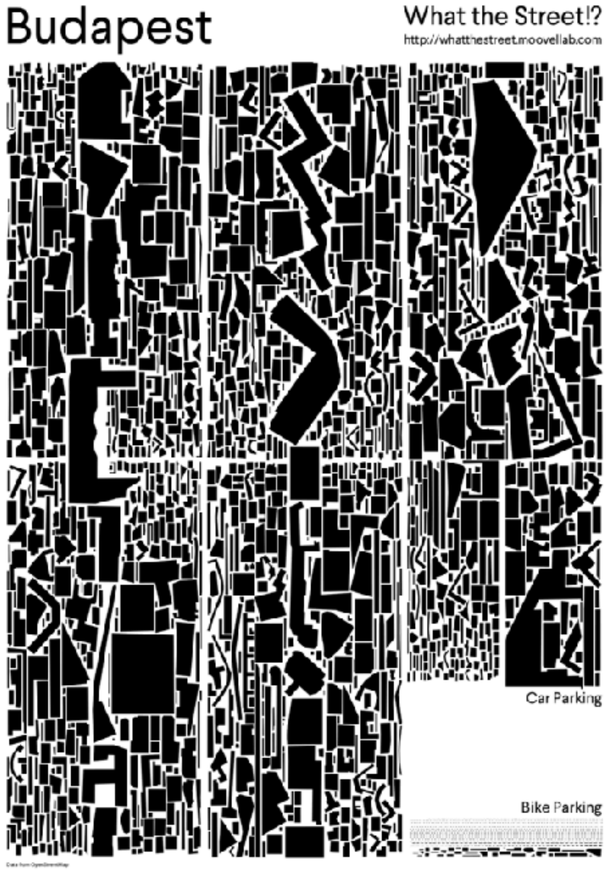

Beach Channel Dr
Rockaway Beach Blvd
Marine Pkwy Bridge
Wheel Fun Rentals

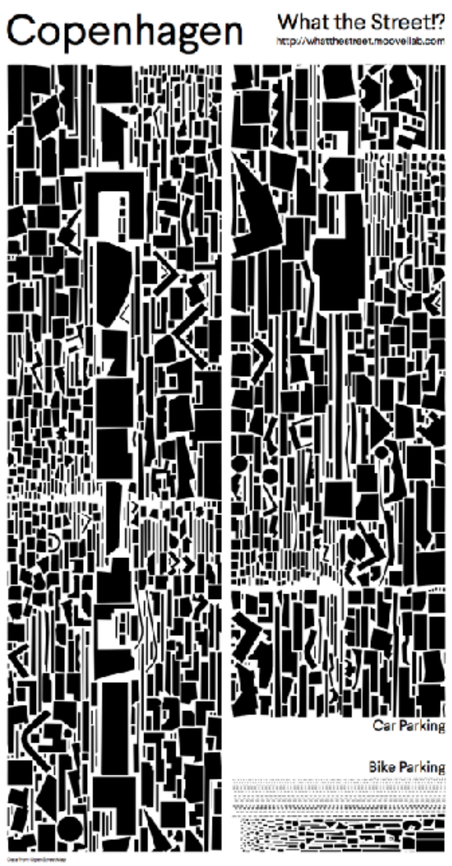



Beach Channel Dr
Rockaway Beach Blvd
Wheel Fun Rentals
The People's Beach at Jacob Riis Park
Beach Bazaar
Wise Clock (aka Riis Park Memorial Clock)

# We visualized ALL parking spaces with polygon packing

# There are huge differences between car and bike parking

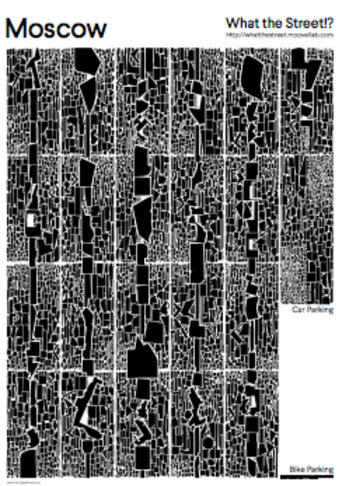



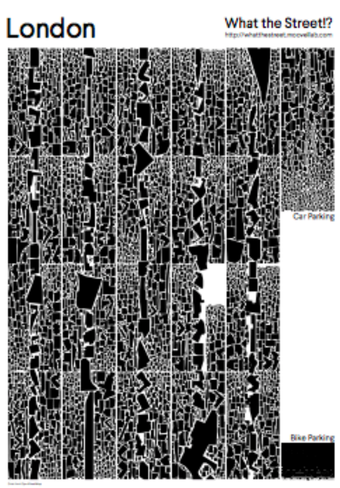



# There are huge differences bet d bike parking

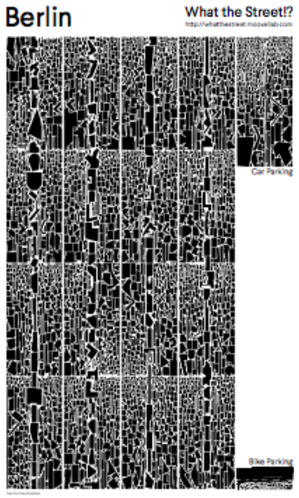
# There are huge differences between car and bike parking

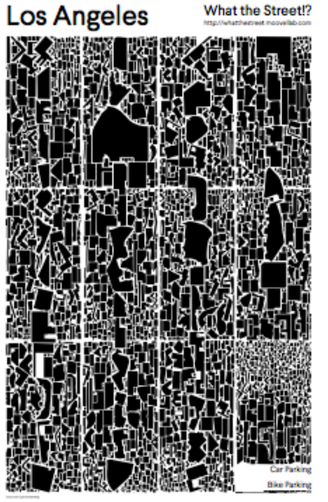
# Our project What the Street!? covers 23 world cities

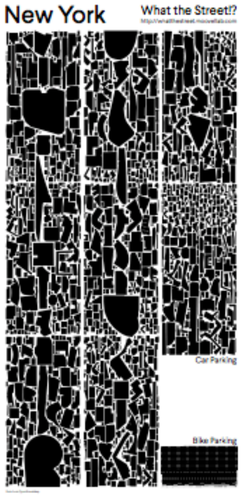


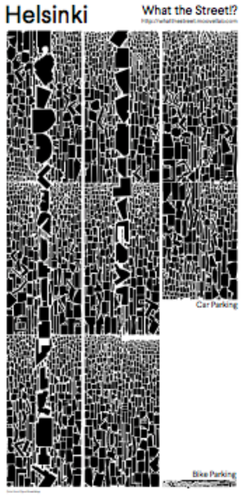



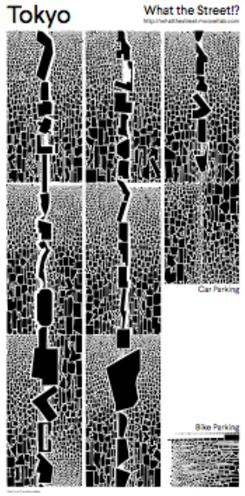


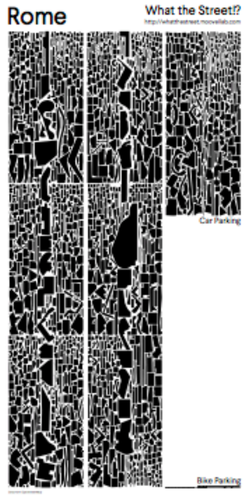


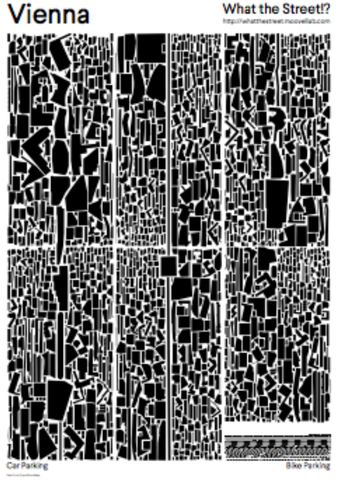




Open-sourced at https://github.com/moovel/lab-what-the-street

Why is there so much car parking?

Is it necessary?

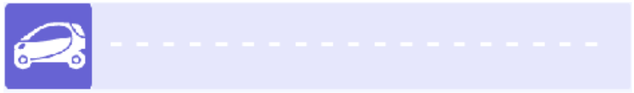
Cars are used 36 minutes per day
Cars are not used 1404 minutes per day

Civity (2016)

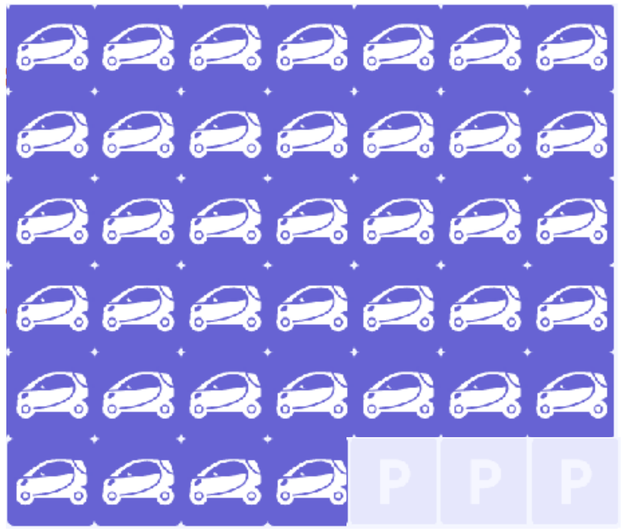
Cars are used 36 minutes per day
Cars are not used 1404 minutes per day

A typical snapshot of Copenhagen

5,500 cars moving



250,000 cars parked



# We are wasting space worth 6,000 playgrounds!

A typical snapshot of Copenhagen

5,500 cars moving

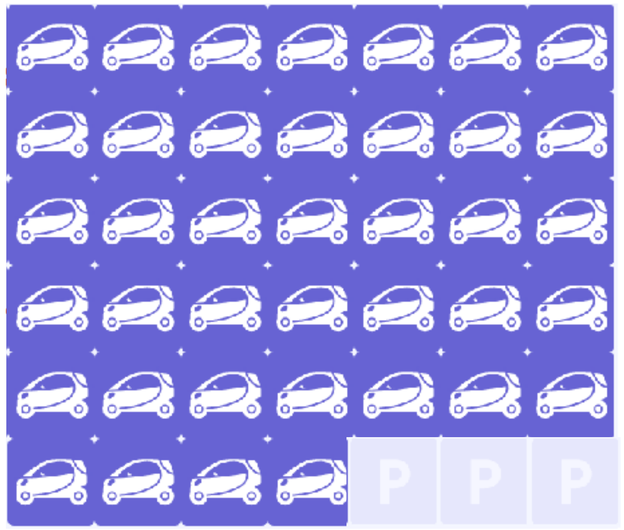
250,000 cars parked

6,000
Playgrounds

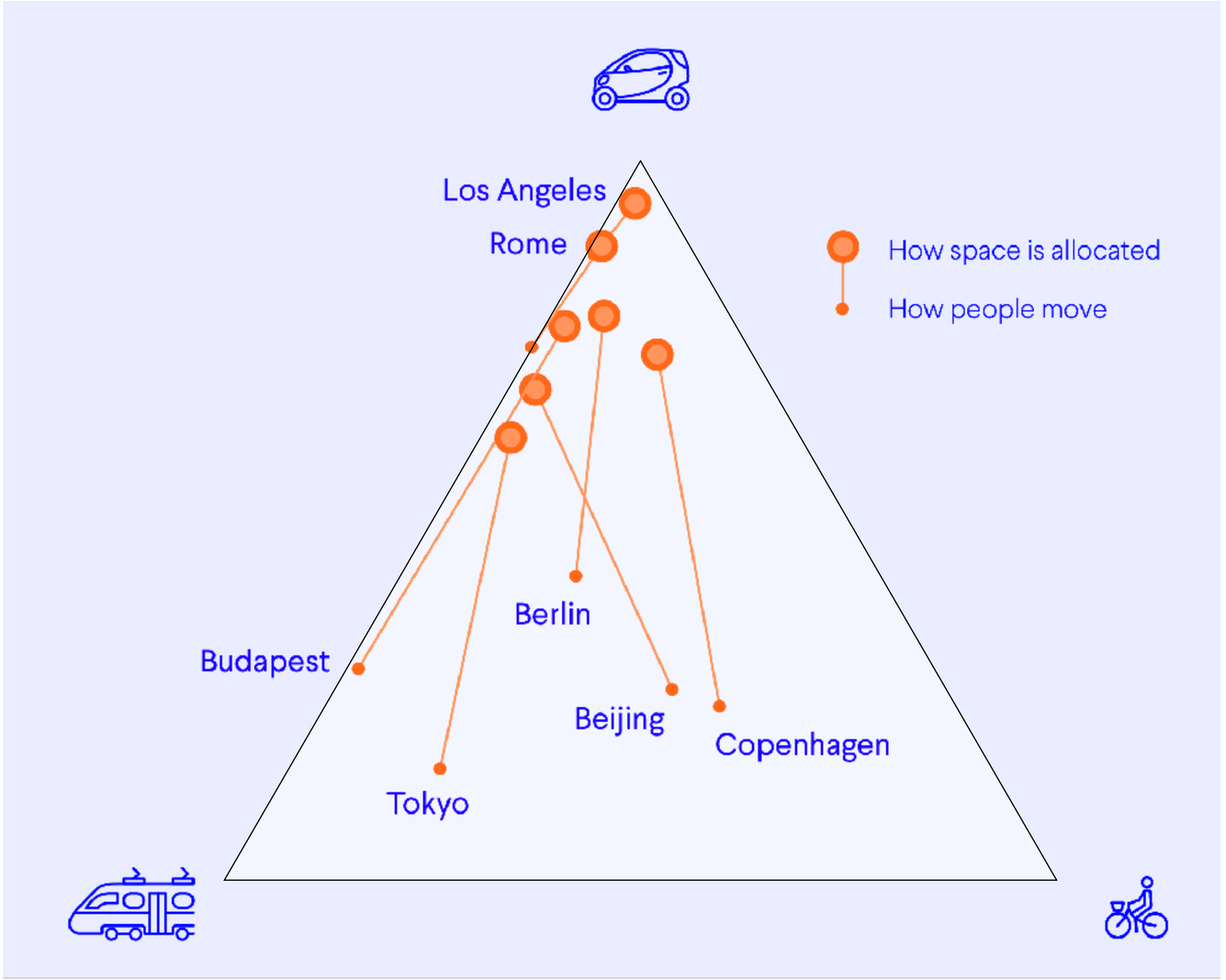
=

2.5×
CHRISTIANIA

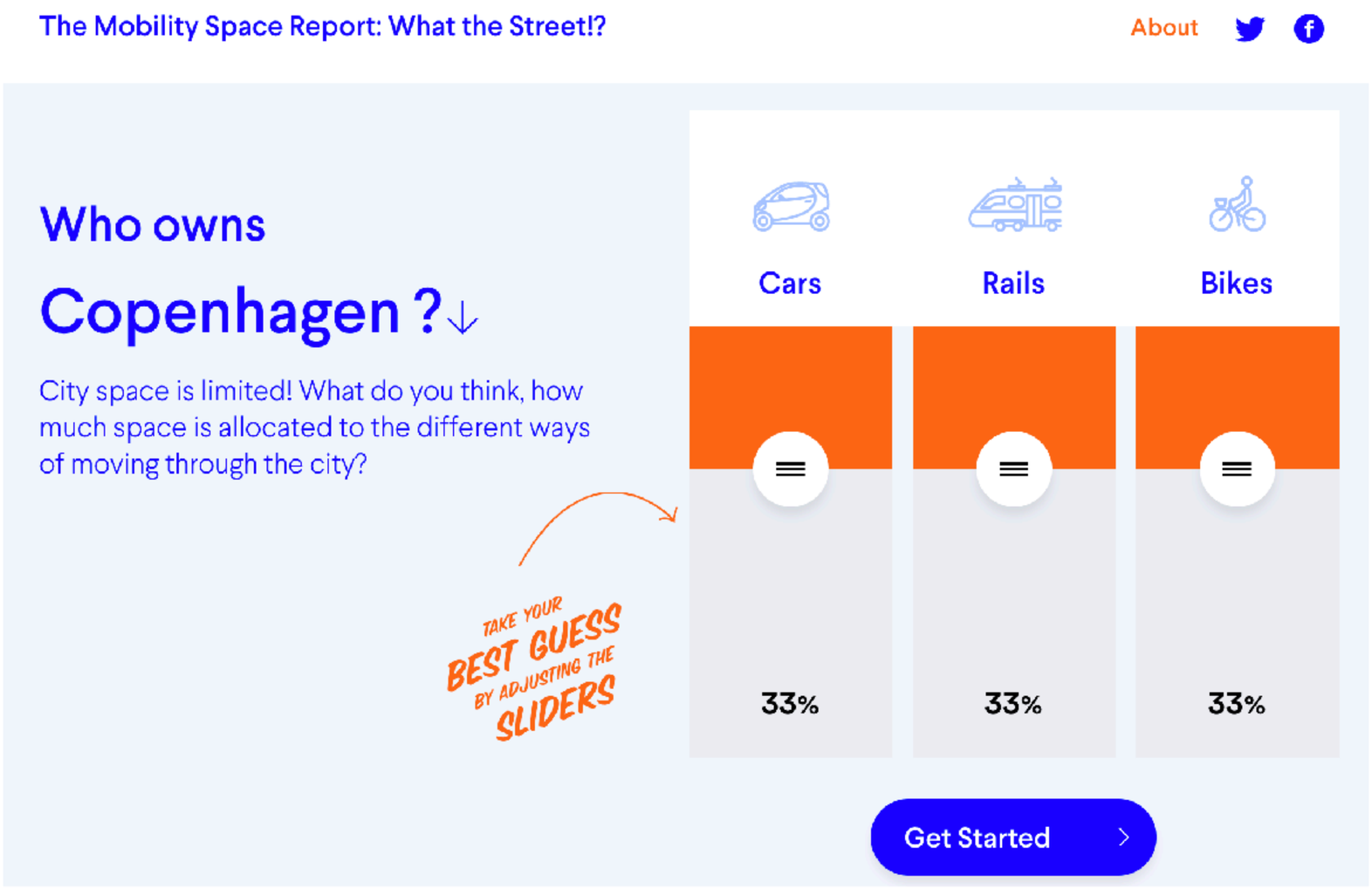
=



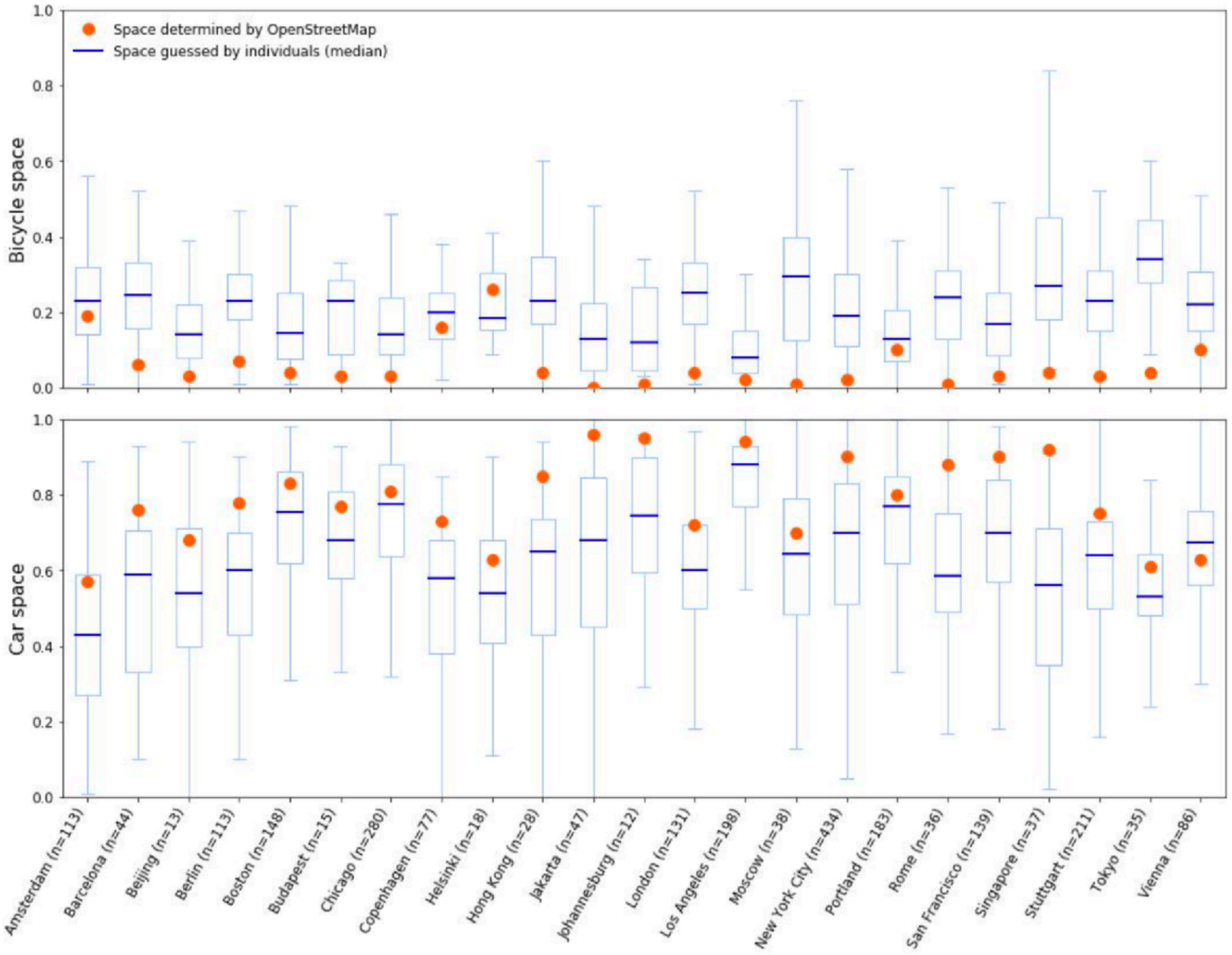
# We developed the mobility triangle
# It shows the arrogance of space with 2 data points



# whatthestreet.moovellab.com



# People underestimate car space, overestimate bike space



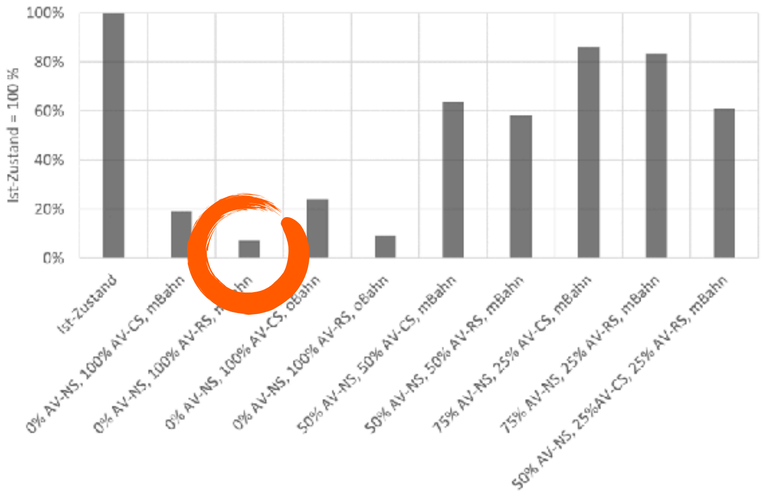

Szell, Urban Planning 3, 1-20 (2018)

How can we get back all the space?

# 10% of self-driving cars can deliver same mobility

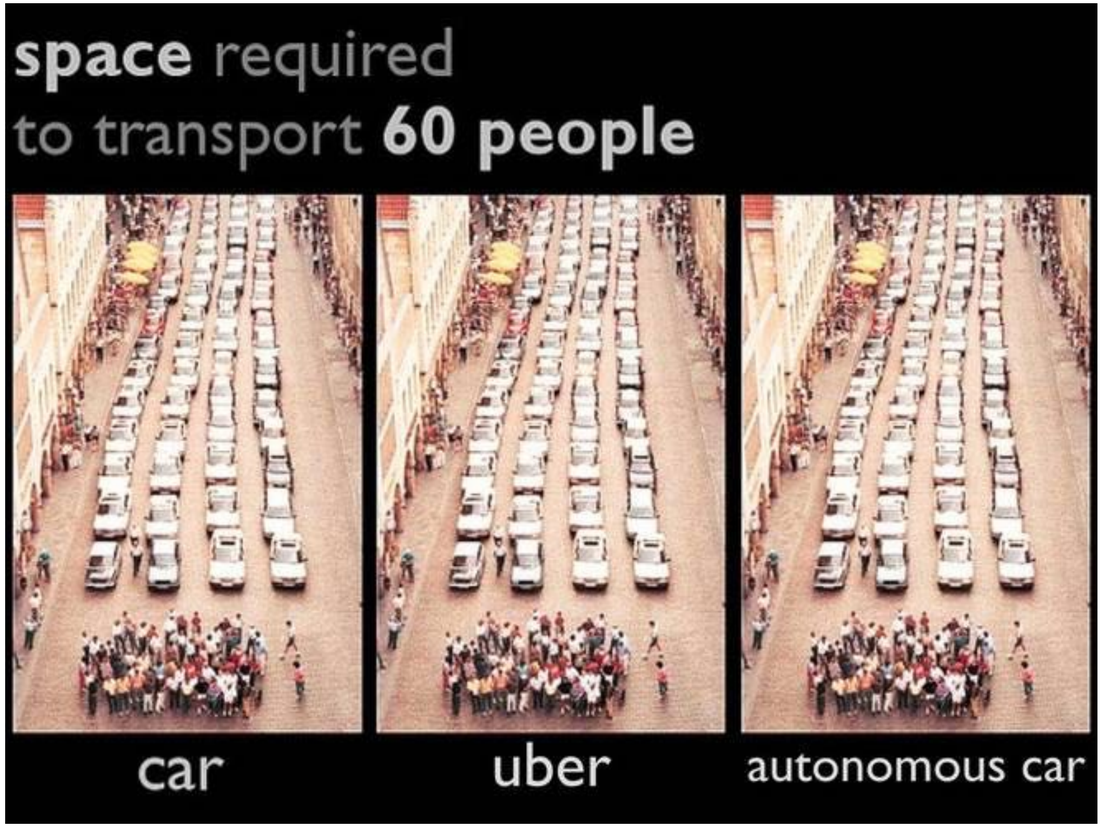

OECD, International Transport Forum (2015)

# 93% of parking spaces could be saved by self-driving, shared vehicles

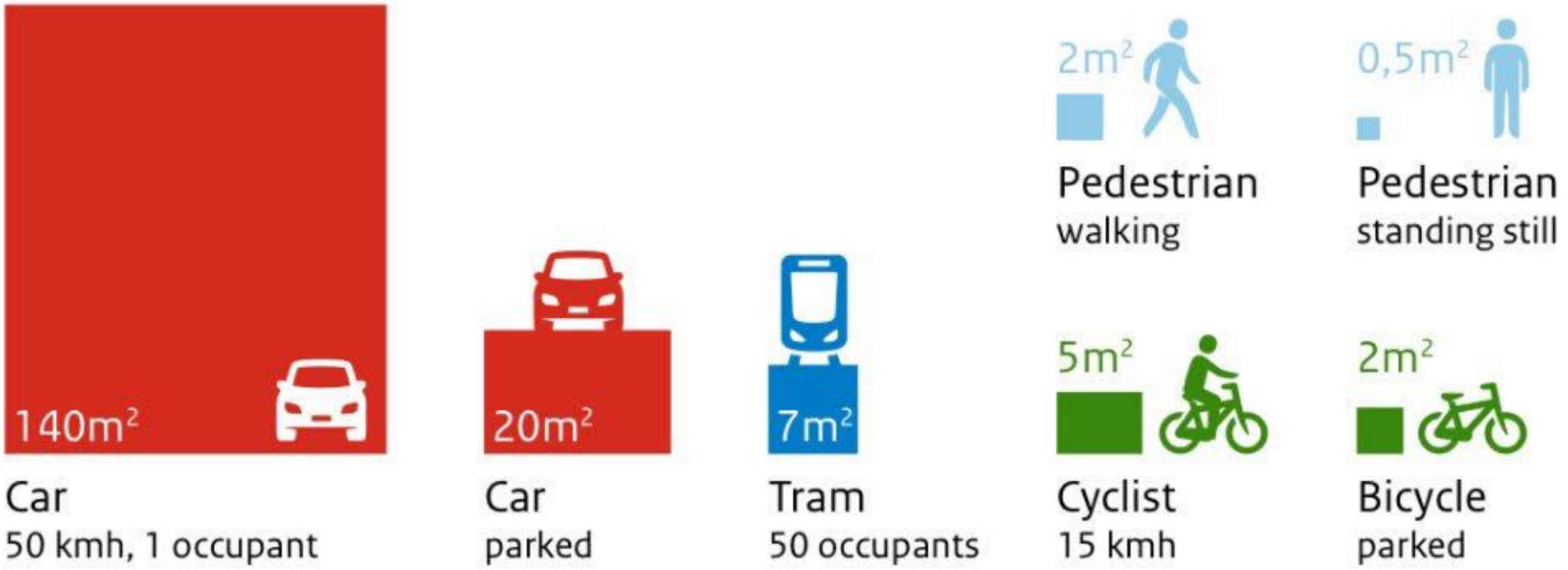




Friedrich & Hartl, Univ Stuttgart (2016)

# Self-driving, shared cars sound nice but are NOT the ultimate solution

# You can't beat geometry:
# Simple geometry tells us cars will ALWAYS be inefficient




Harms and Kansen, Netherlands Institute for Transport Policy Analysis (2017)
Szell, Urban Planning 3, 1-20 (2018)

# Ongoing research:
# Connecting / growing bicycle networks

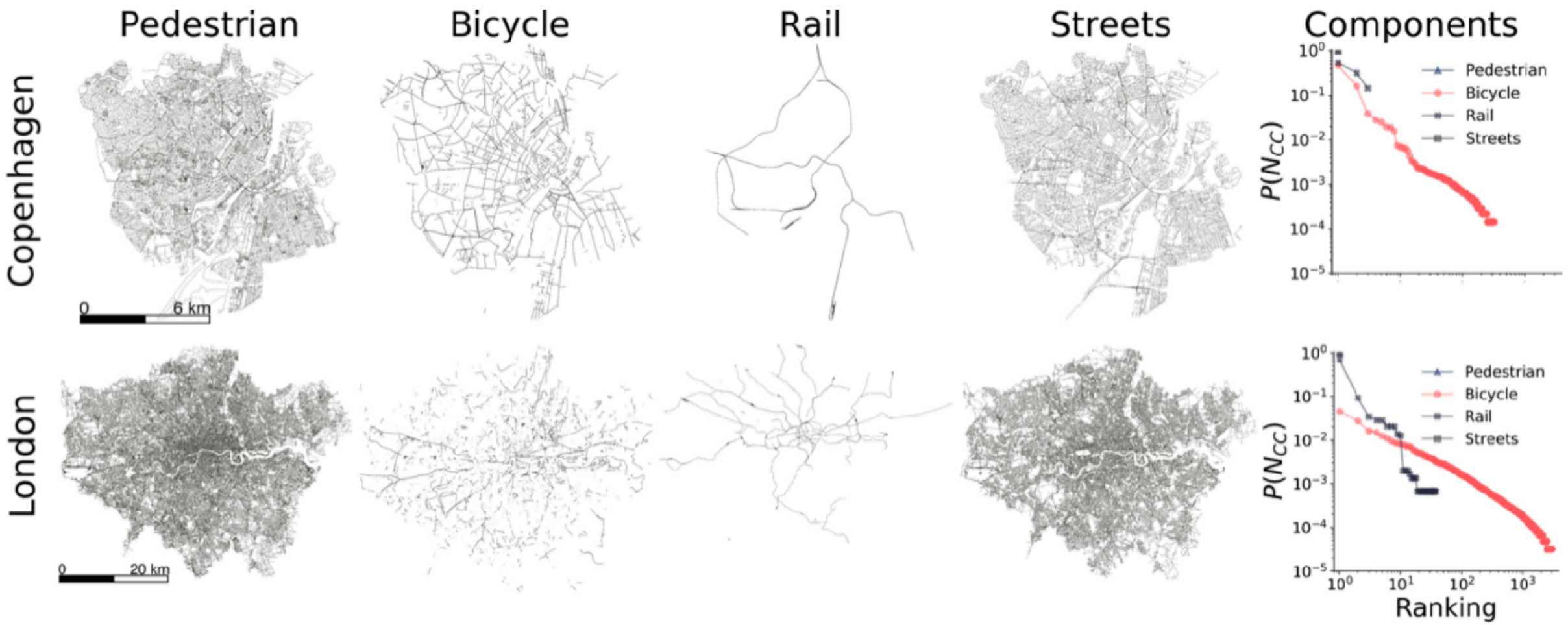
# Data-driven strategies for optimal bicycle network growth

Luis Guillermo Natera Orozco[1], Federico Battiston[1], Gerardo Iñiguez[1,2,3], Michael Szell[4,5*]

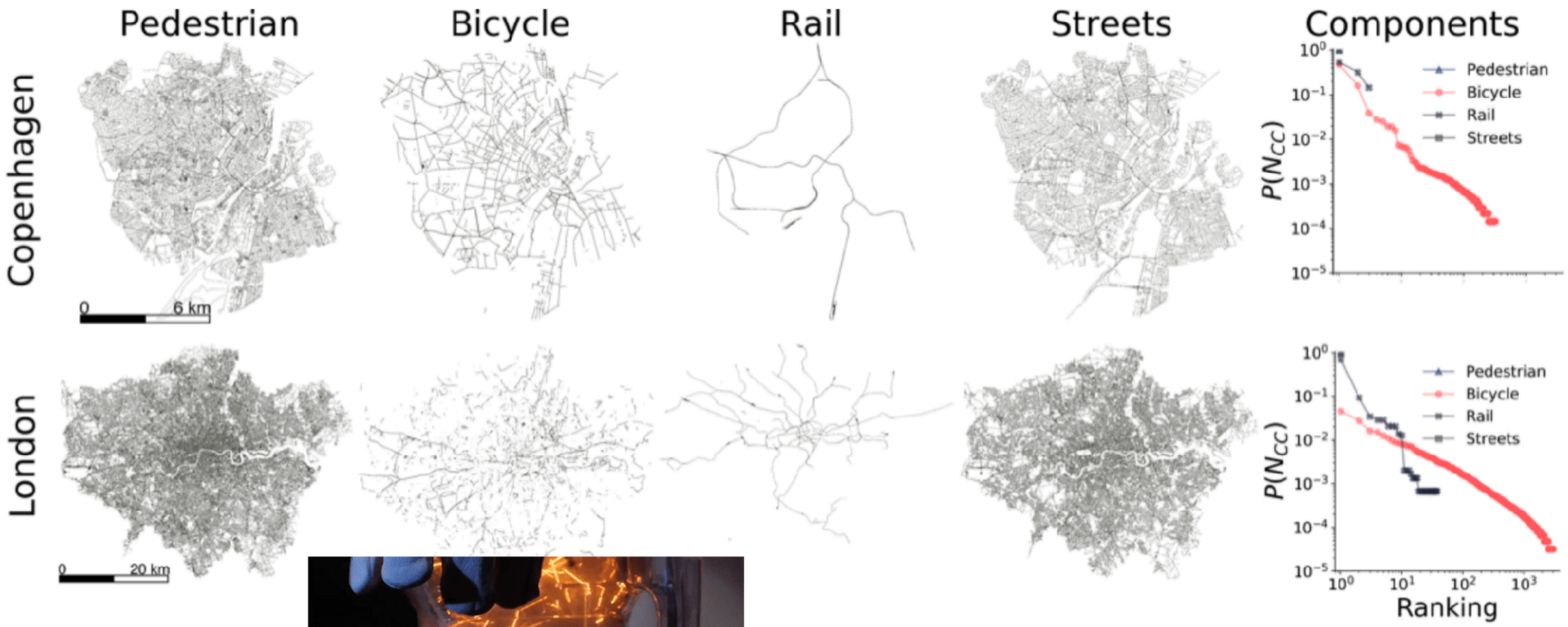
1) Department of Network and Data Science
Central European University, H-1051 Budapest, Hungary
2) Department of Computer Science, Aalto University School of Science, FI-00076 Aalto, Finland
3) IIMAS, Universidad Nacional Autonóma de México, 01000 Ciudad de México, Mexico
4) NEtwoRks, Data, and Society (NERDS), IT University of Copenhagen, DK-2300 Copenhagen, Denmark
5) Complexity Science Hub Vienna, 1080 Vienna, Austria

https://arxiv.org/abs/1907.07080

# Bicycle networks are highly fragmented

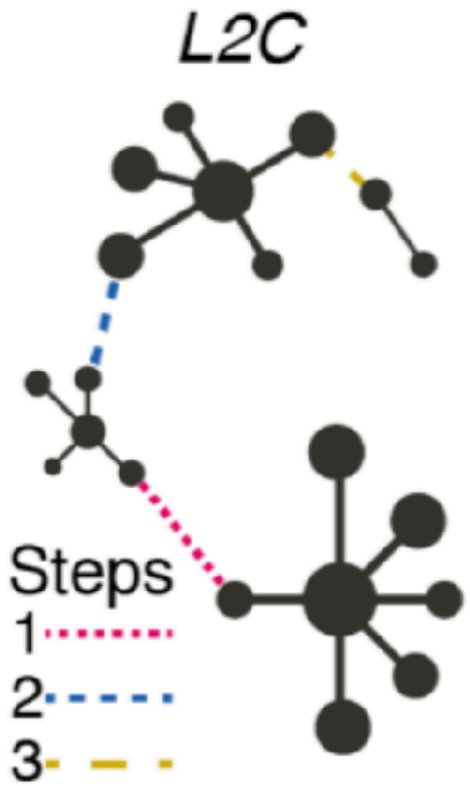


# Bicycle networks are highly fragmented




# How should we connect the components?

Largest to closest



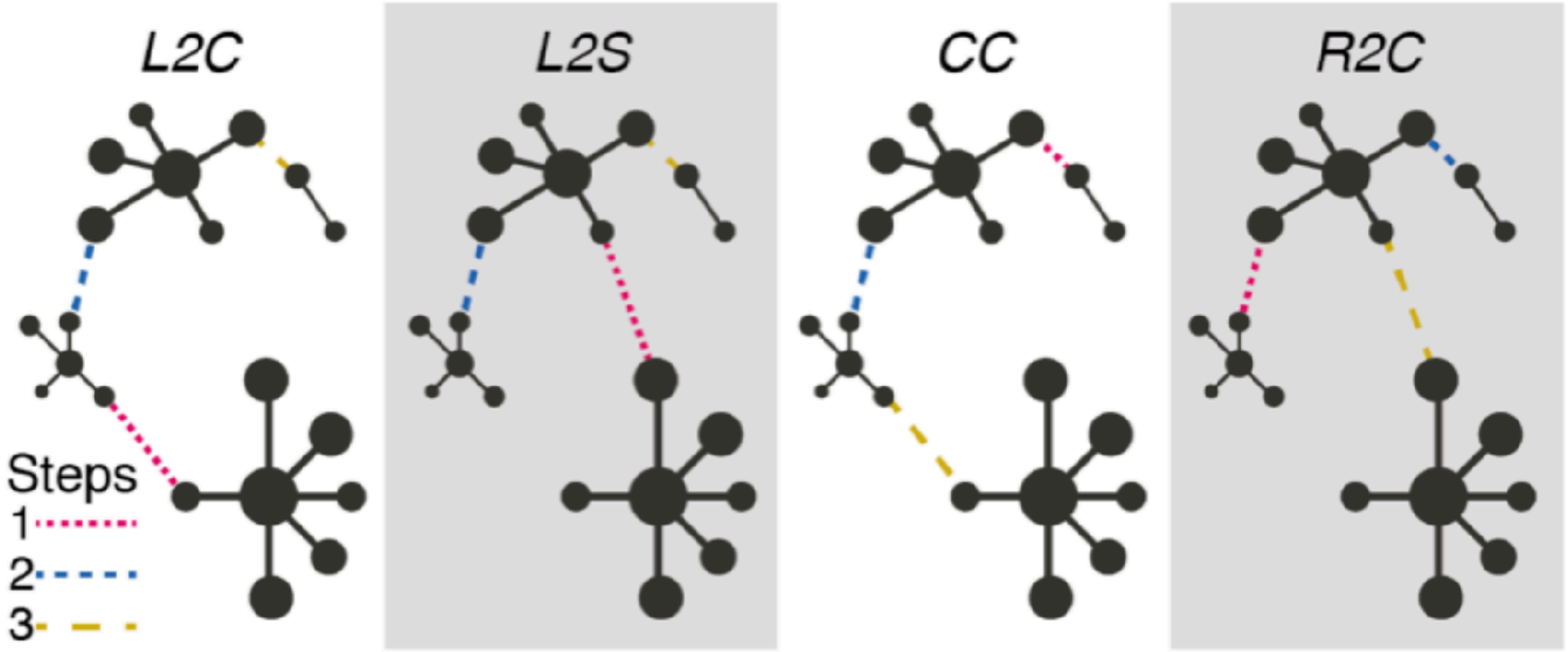
# How should we connect the components?

Largest to closest

Largest to second largest

Closest components

Random to closest



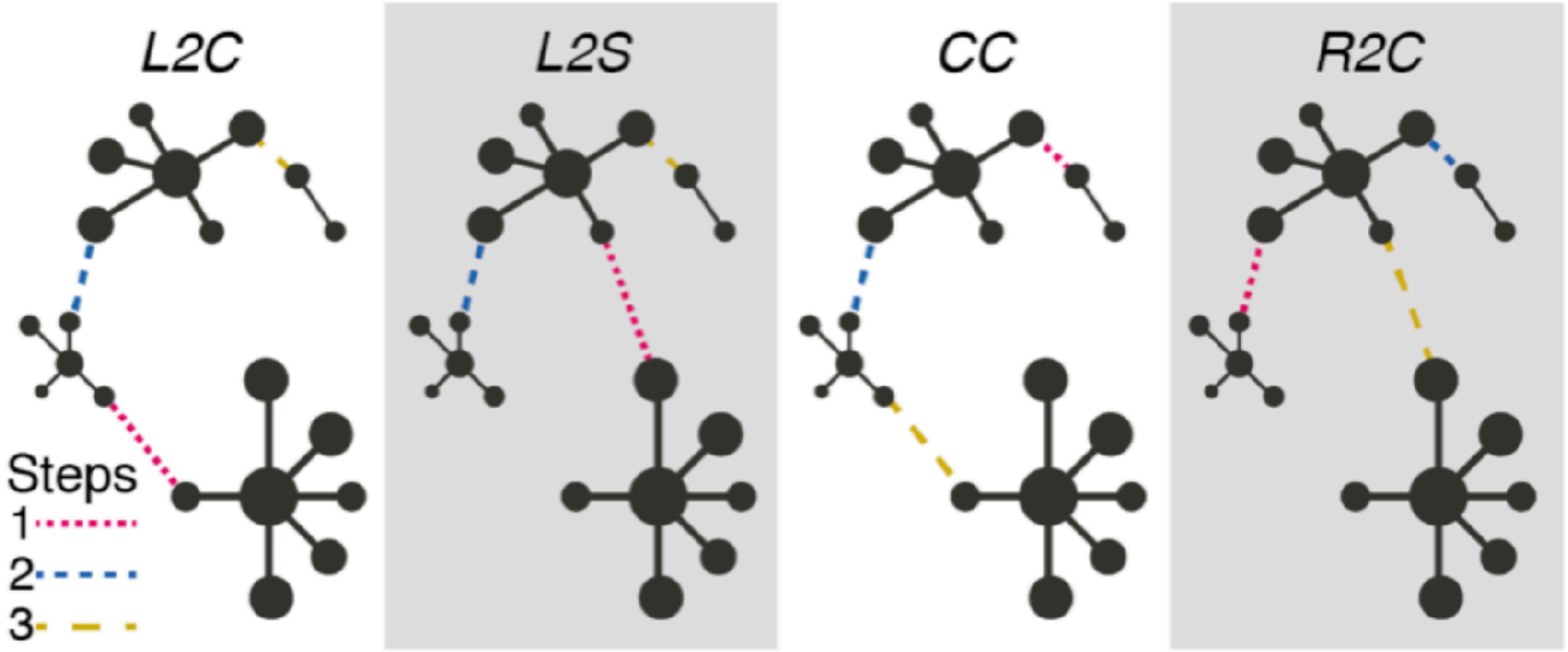
# How should we connect the components?

Largest to closest

Largest to second largest

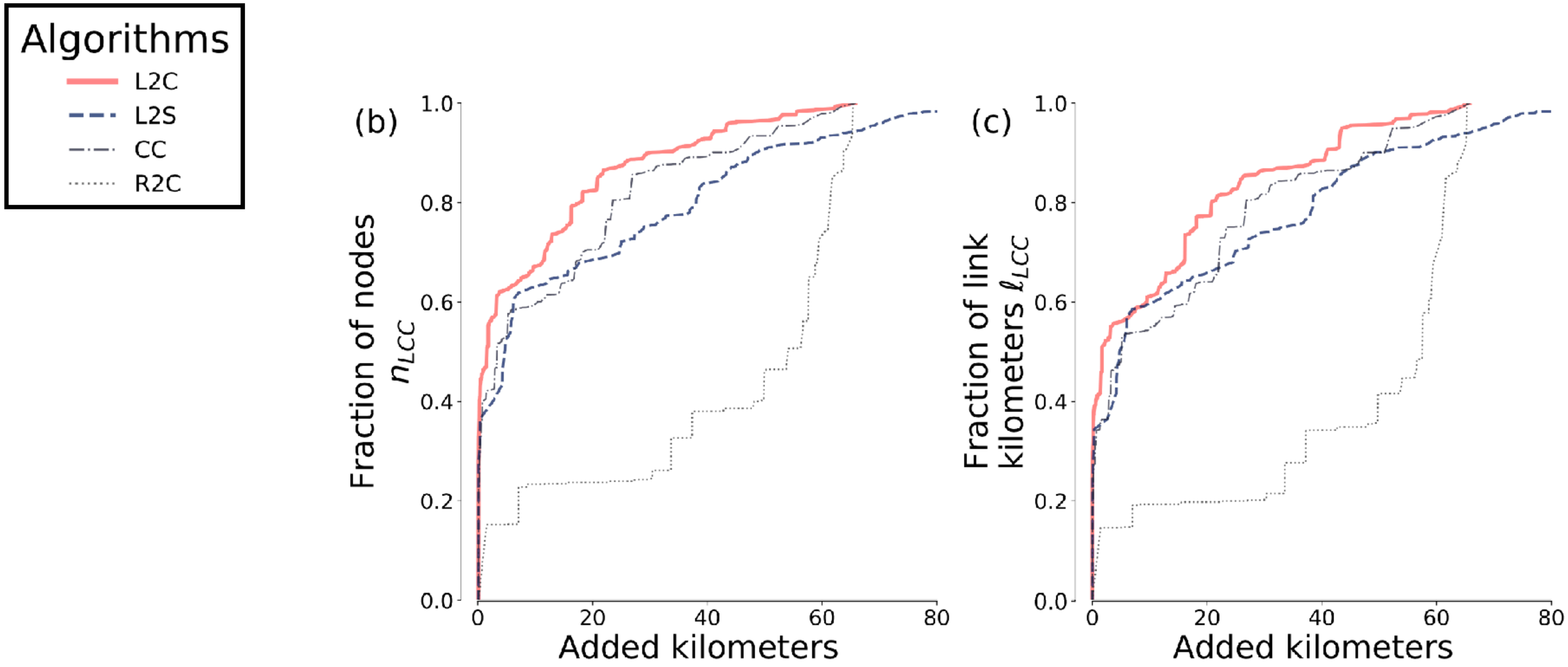
Closest components

Random to closest

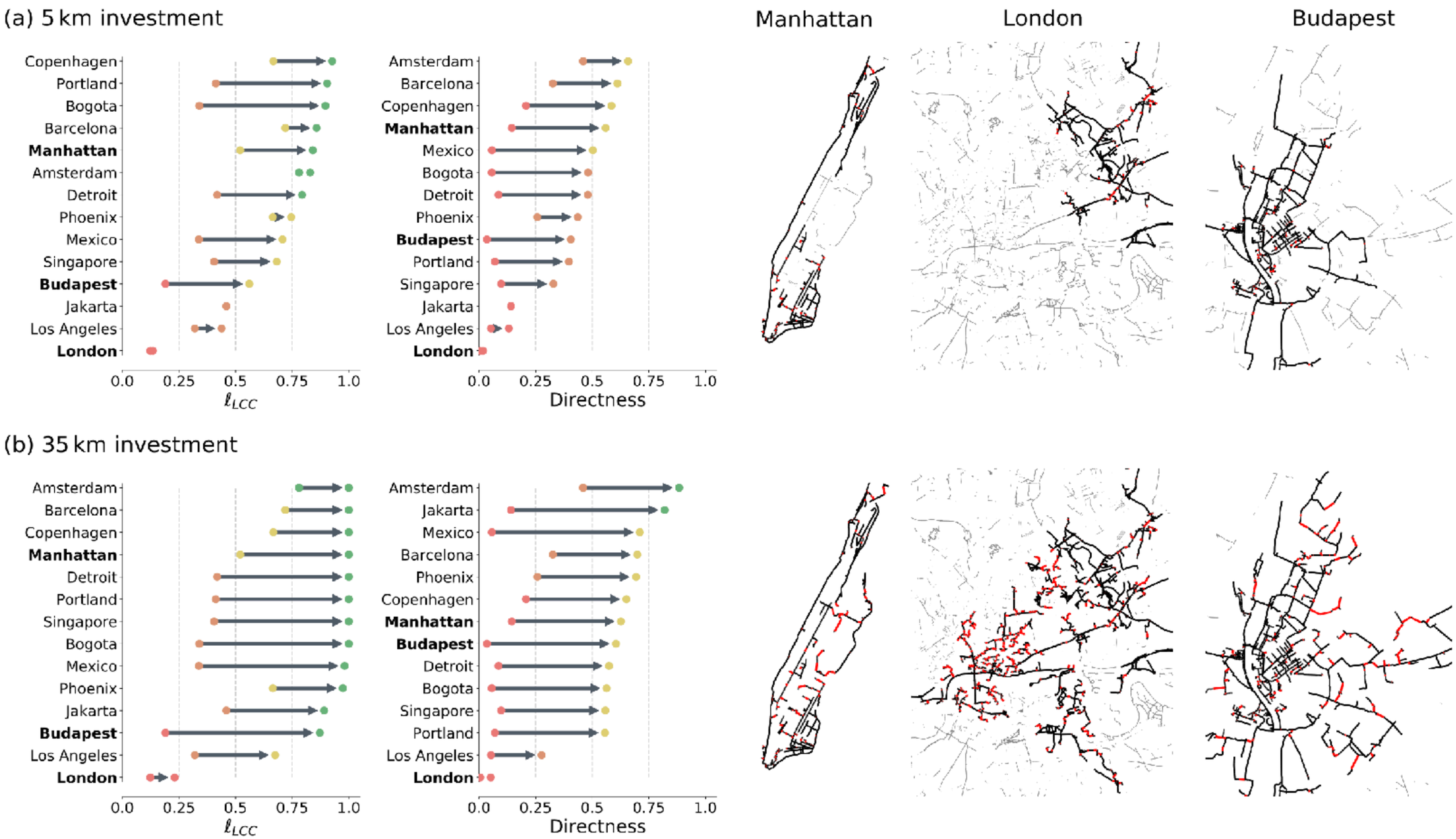



Greedy investment (Kruskal)

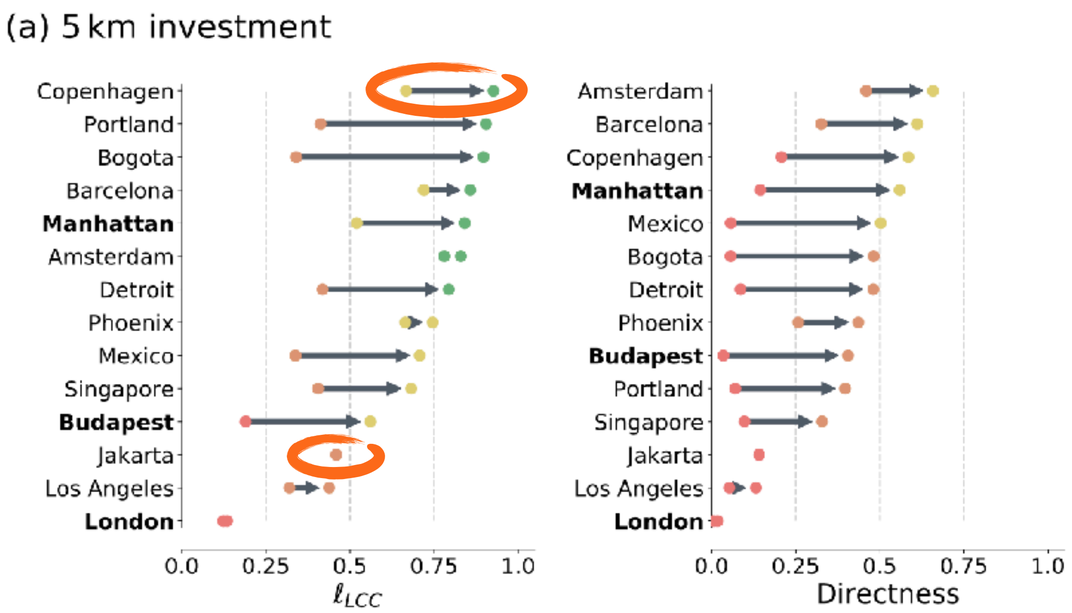
# Largest to closest component gives best results

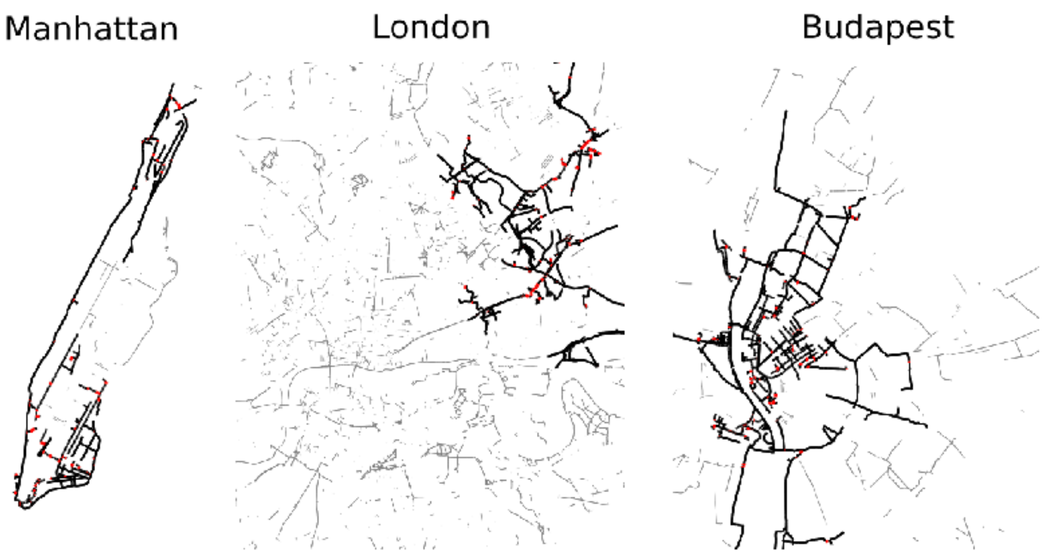


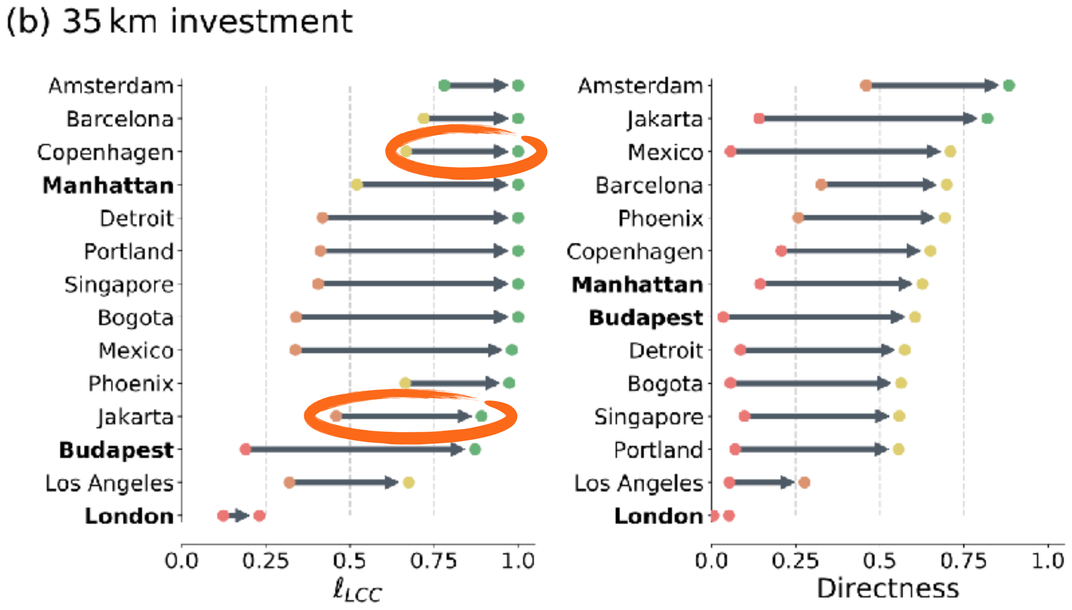
# Invest little or much? Depends on the city

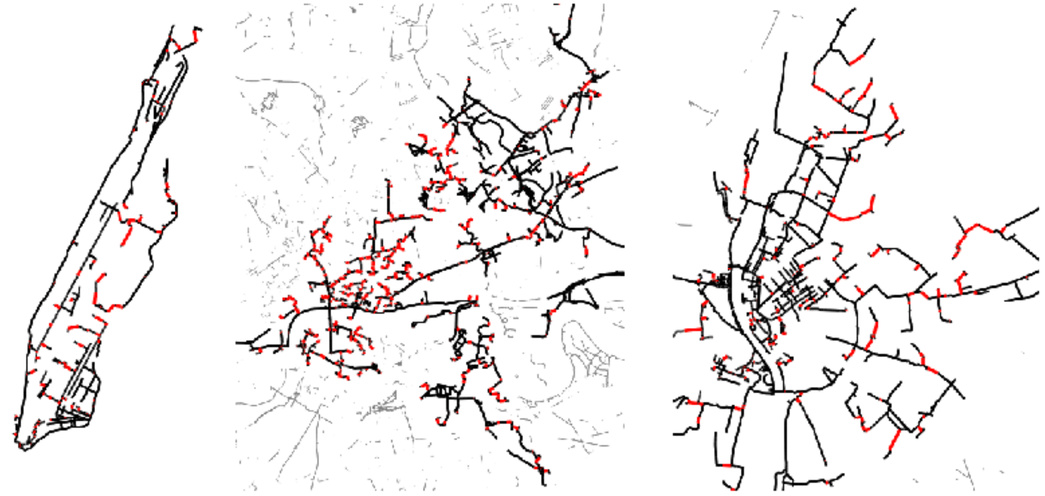


# Invest little or much? Depends on the city



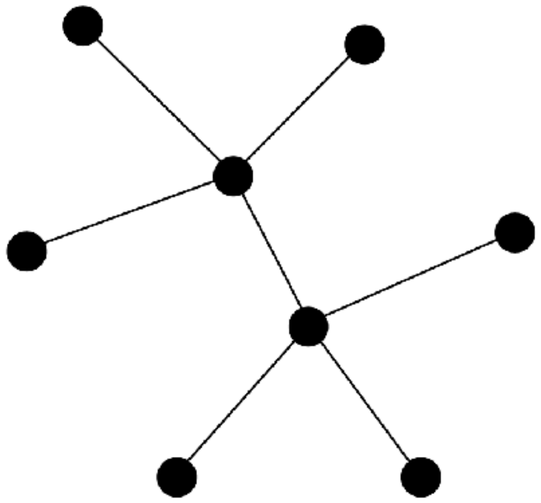



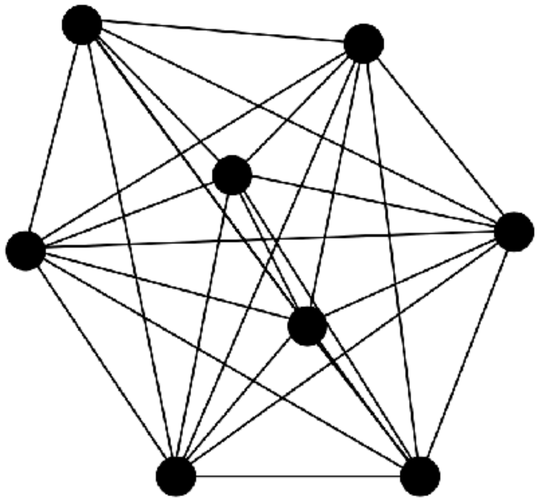
# It is not enough to just connect components

A minimum spanning tree has no redundancy, and no:

- Fault tolerance (roadworks, traffic)
- Directness



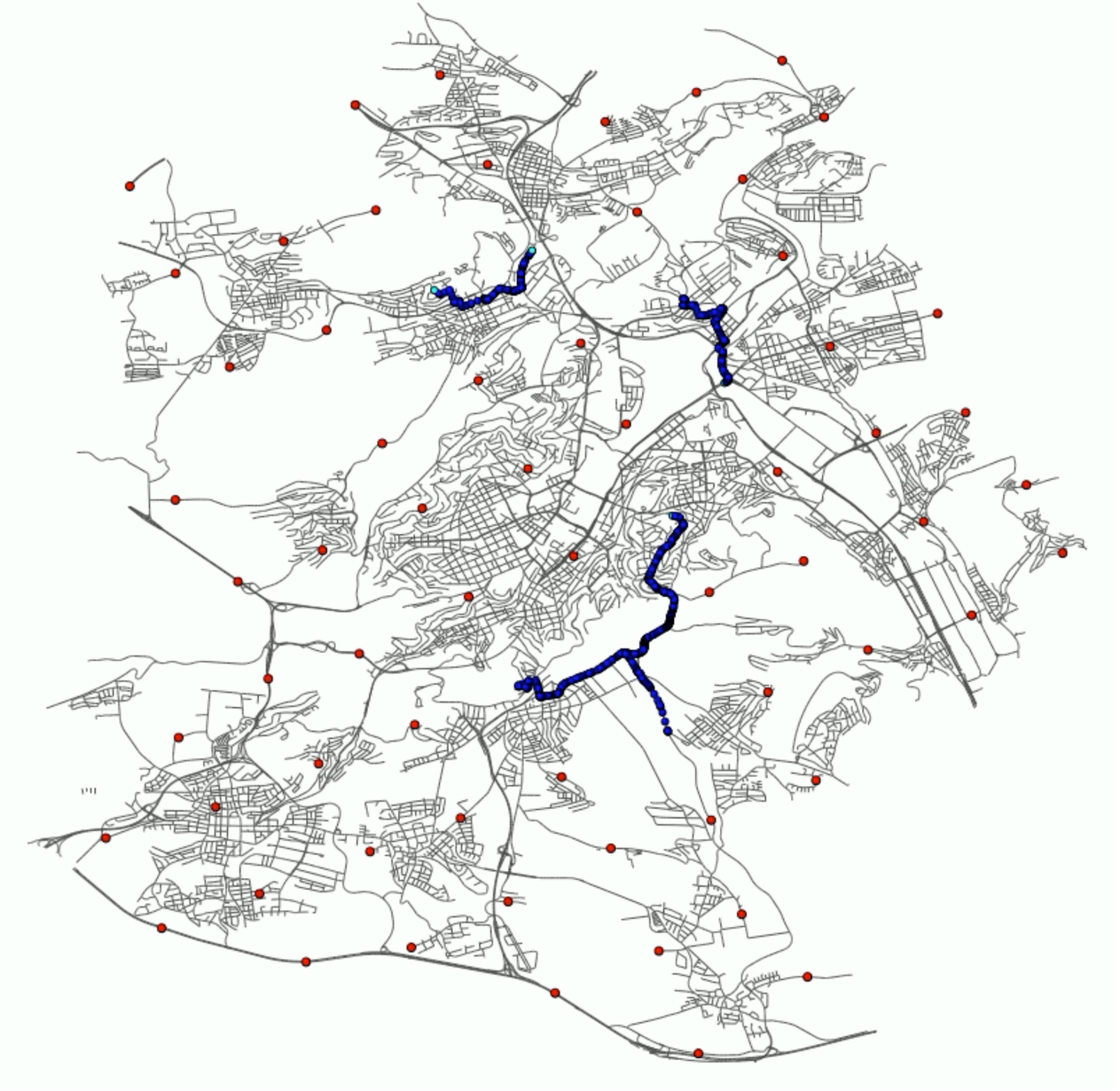
Investors' optimum



Travellers' optimum

van Nes, Univ of Delft (2002)

# We are systematically exploring bike network growth space



# First step: Topology. Then: Consider more data.

Contents lists available at ScienceDirect

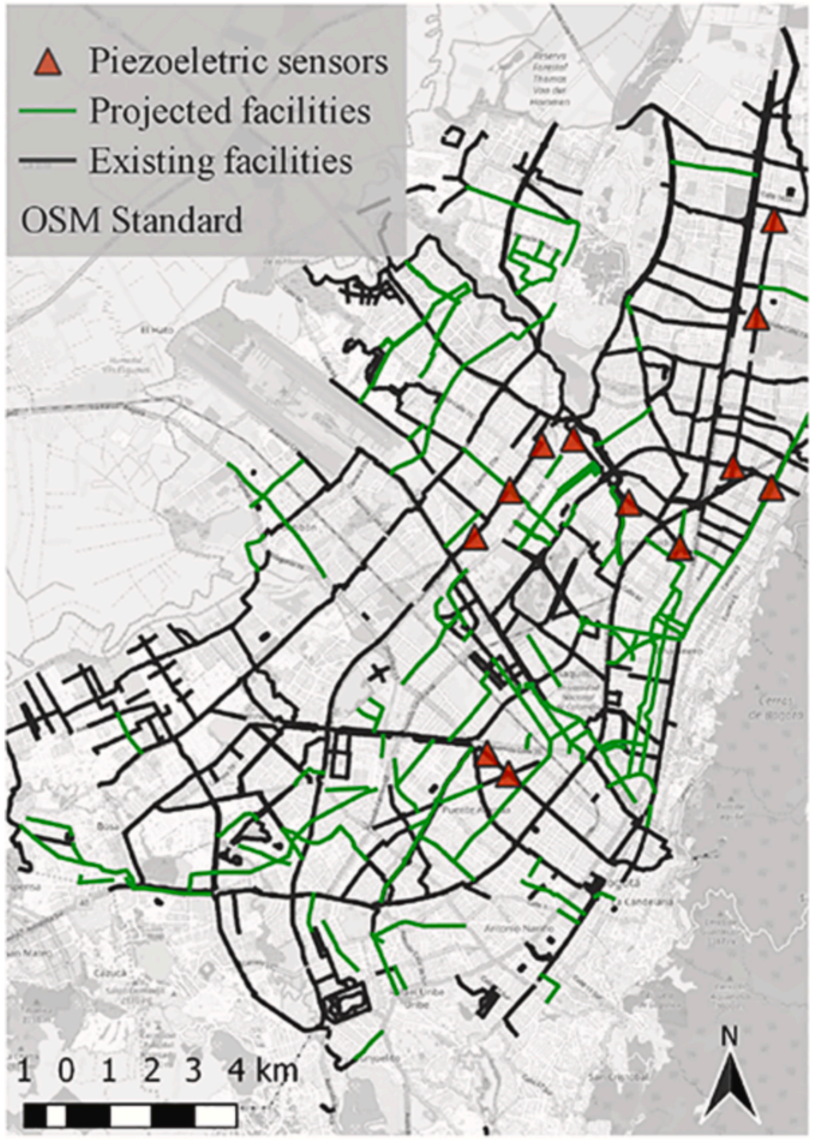
Transportation Research Part C

journal homepage: www.elsevier.com/locate/trc

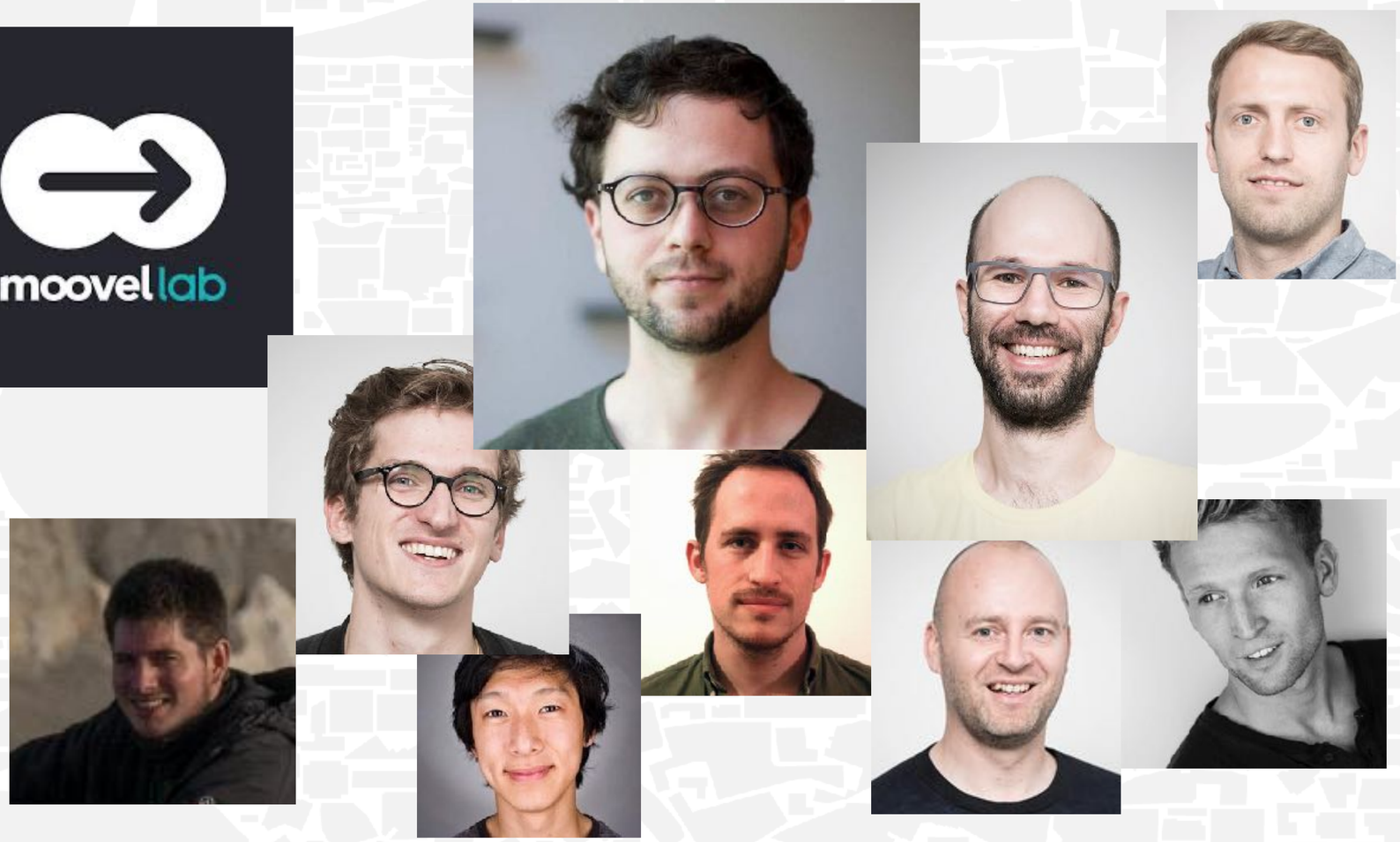
A data science framework for planning the growth of bicycle infrastructures☆

Luis E. Olmos[a,*,1], Maria Sol Tadeo[b,1], Dimitris Vlachogiannis[b], Fahad Alhasoun[c], Xavier Espinet Alegre[d], Catalina Ochoa[d], Felipe Targa[d], Marta C. González[a,b,e]

- OD matrices
- Mobile phone GPS
- Census
- Mobility surveys
- Bicycle counters
- Planned bicycle networks



moovellab



Stephan Bogner, Benedikt Gross, Tobias Lauer, Anagrama, Tilman Häuser, Raphael Reimann, Daniel Schmid, Joey Lee, Johannes Wachs, Thibault Durand

Luis Guillermo Natera Orozco, Federico Battiston, Gerardo Iniguez, Gourab Ghoshal, Sayat Mimar, Tyler Perlman, Roberta Sinatra

# Urban Data Science needs to focus on humans. Technology-centered solutions can sometimes be overkill.


Michael Szell
michael.szell.net
@mszll
misz@itu.dk