

# Digital Footprint Data for Population Movement

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[www.franciscorowe.com](http://www.franciscorowe.com)

 @fcorowe

# Github Repository & Data Access

# Link

**Descarga del repositorio:**

**[https://fcorowe.github.io/dfd4mobility\\_mx/](https://fcorowe.github.io/dfd4mobility_mx/)**

**Ver instrucciones detalladas en un  
correo electrónico enviado por Miguel  
el 03/04/2024**

# **Overview: Digital Footprint Data**

# Structure

1. Introduction to human mobility  
& digital footprint data

2. Opportunities of  
digital footprint data

3. Facebook data

# Human Mobility

Causes



Place inequalities



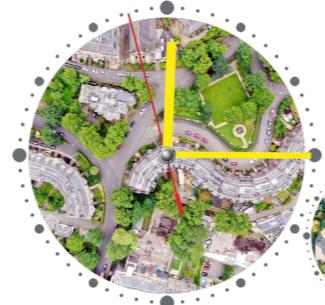
Population inequalities



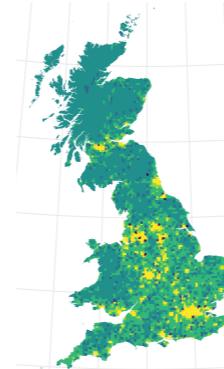
Individual inequalities

Geographical scale

Local urban mobility



Internal migration



International migration



Impacts

Place inequalities

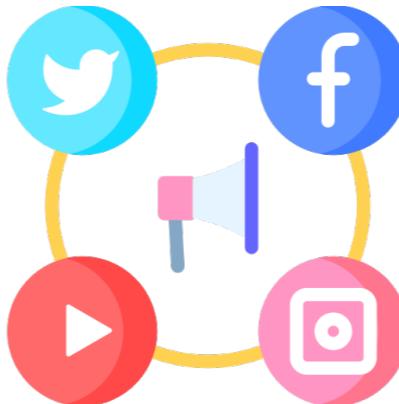
Population inequalities

Individual inequalities

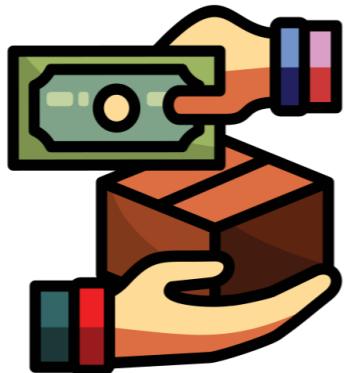
# Digital Footprint Data?



Internet



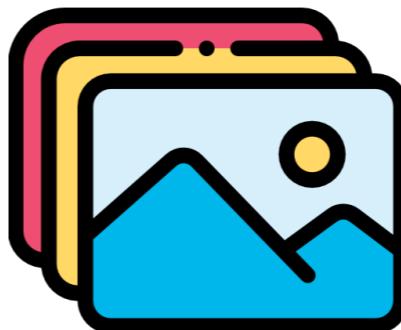
Social media



Commercial & transactional



Sensor



Imagery

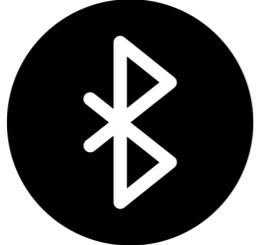
# Data for Mobility



**CDR/XDR**  
~100m-1km  
~30min



**GPS**  
~5-20m  
~10-25min



**Bluetooth**  
~1-10m



**Smart card**  
location



Source: Rowe and Patias (2020)

**\*Warning\* Not collected for research purposes**

# Opportunities

# High resolution

## Geographical and temporal granularity



To travel or not to travel: 'Weather' is the question. Modelling the effect of local weather conditions on bus ridership 

Sui Tao<sup>a,\*</sup>, Jonathan Corcoran<sup>b</sup>, Francisco Rowe<sup>c</sup>, Mark Hickman<sup>d</sup>

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<sup>b</sup> School of Earth and Environmental Sciences, The University of Queensland, 4072, Australia

<sup>c</sup> Department of Geography and Planning, School of Environmental Sciences, University of Liverpool, Liverpool L69 7ZT, UK

<sup>d</sup> School of Civil Engineering, The University Queensland, 4072, Australia

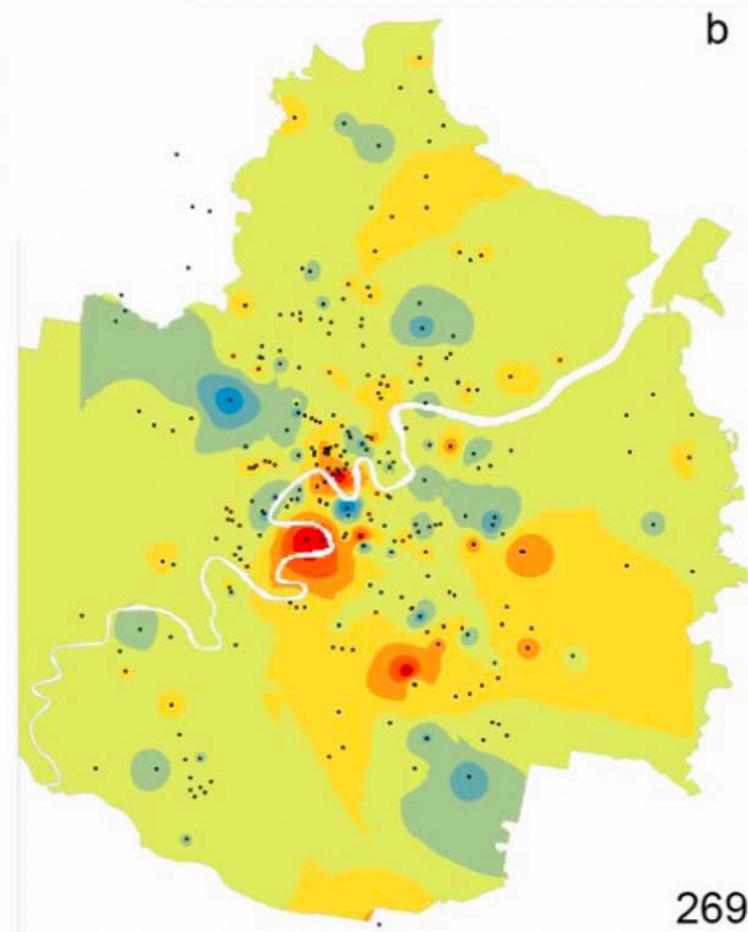
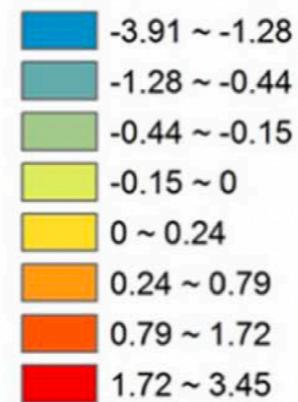
### ARTICLE INFO

Keywords:  
Public transport  
Weather  
Time-series modelling  
Travel behaviour

### ABSTRACT

While the influence of weather on public transport performance and ridership has been the topic for some research, the real-time response of transit usage to variations in weather conditions is yet to be fully understood. This paper redresses this gap by modelling the effect that local weather conditions exert on hourly bus ridership in sub-tropical Brisbane, Australia. Drawing on a transit smart card data set and detailed weather measurements, a suite of time-series regression models are computed to capture the concurrent and lagged effects that weather conditions exert on bus ridership. Our findings highlight that changes in particularly temperature and rainfall were found to induce significant hour-to-hour changes in bus ridership, with such effects varying markedly across both a 24 h period and the transit network. These results are important for public transport service operations in their capacity to inform timely responses to real-time changes in passengers' travel demand induced by the onset of particular weather conditions.

### Rainfall



b

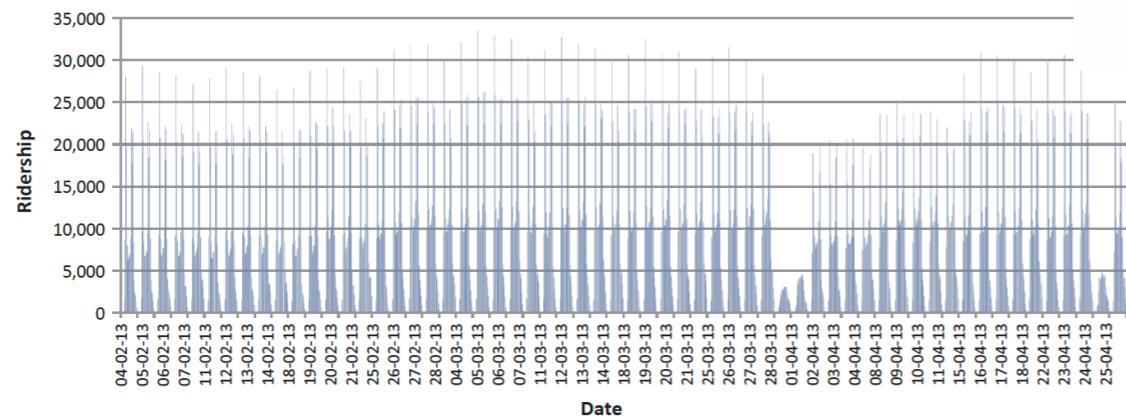


Fig. 6. Weekday hourly ridership.

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# Greater geographical coverage

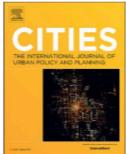
## Assessing stay-at-home at a global scale



Contents lists available at ScienceDirect

### Cities

journal homepage: [www.elsevier.com/locate/cities](http://www.elsevier.com/locate/cities)



Sensing global changes in local patterns of energy consumption in cities during the early stages of the COVID-19 pandemic

Francisco Rowe<sup>a,\*</sup>, Caitlin Robinson<sup>b</sup>, Nikos Patias<sup>a</sup>

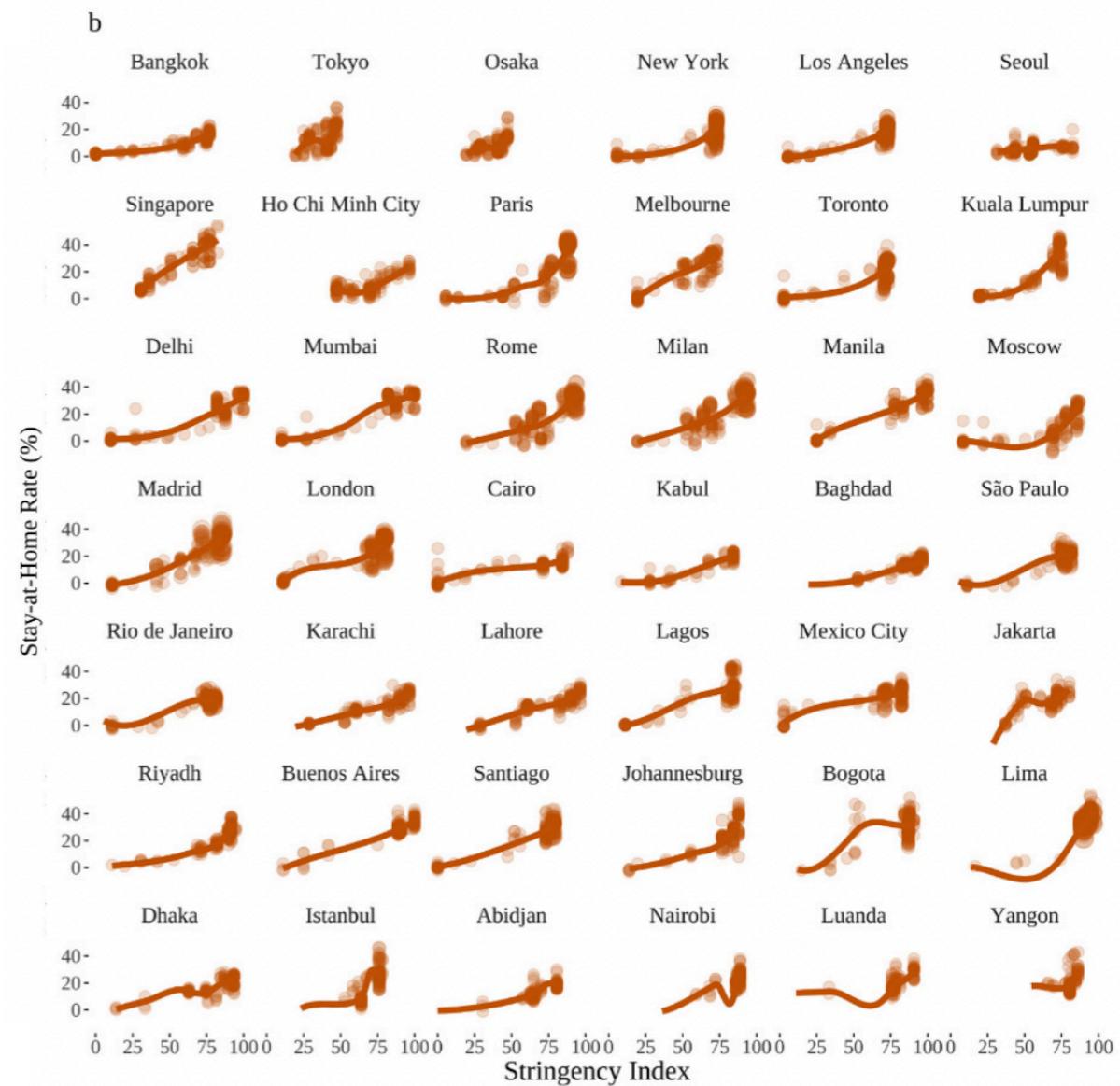
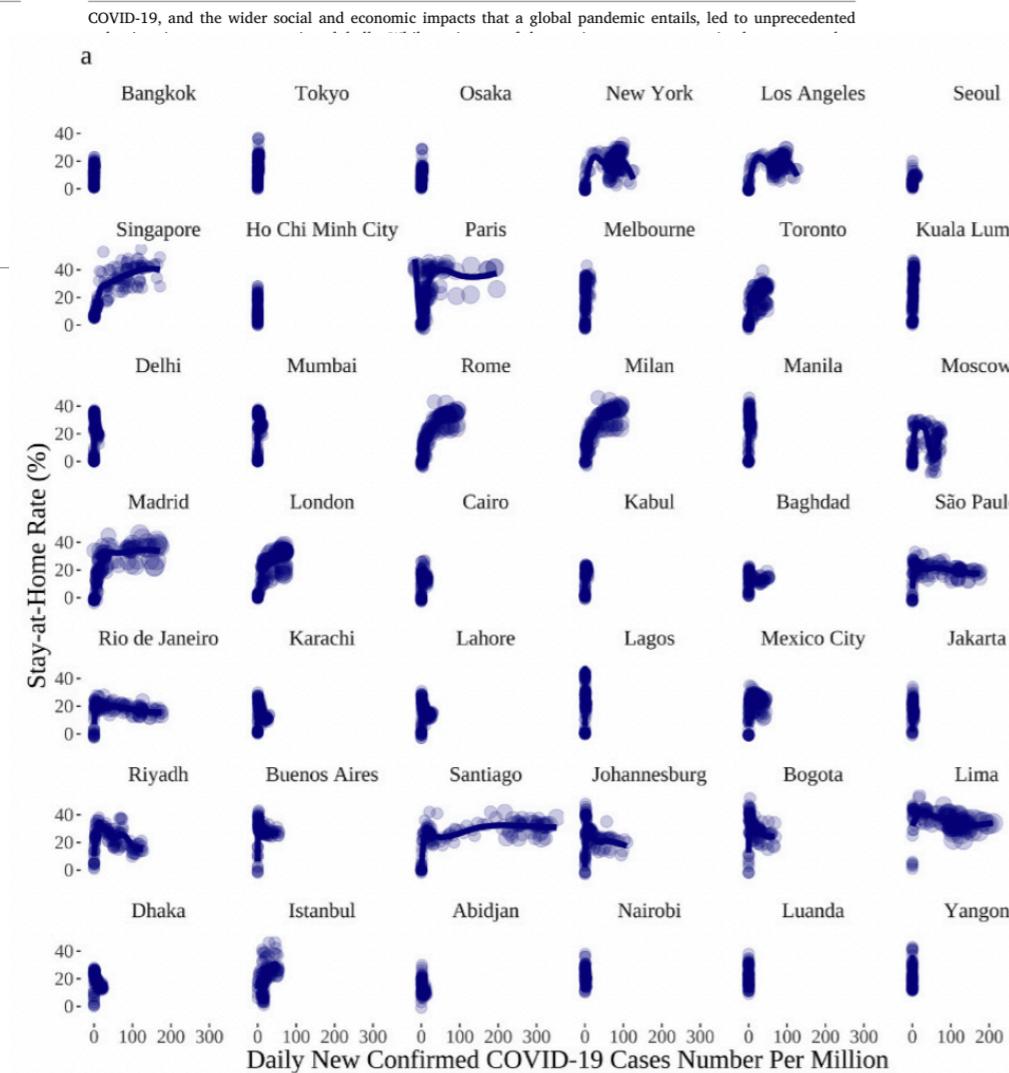
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#### ARTICLE INFO

#### ABSTRACT

Keywords:  
COVID-19  
Urban energy use  
Mobility  
Night-time light satellite imagery  
Cities



# Near real-time availability

## Measuring conflict-induced population displacement

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### RESEARCH ARTICLE

WILEY

### Where have Ukrainian refugees gone? Identifying potential settlement areas across European regions integrating digital and traditional geographic data

Miguel González-Leonardo<sup>1,2</sup> | Ruth Neville<sup>3</sup>  | Sofía Gil-Clavel<sup>4,5</sup> | Francisco Rowe<sup>3</sup>

<sup>1</sup>Centre for Demographic Urban and Environmental Studies, El Colegio de México, Mexico City, Mexico

<sup>2</sup>International Institute for Applied Systems Analysis, Wittgenstein Centre, Laxenburg, Austria

<sup>3</sup>Geographic Data Science Lab, Department of Geography and Planning, University of Liverpool, Liverpool, UK

<sup>4</sup>Faculty of Technology, Policy, and Management, TU Delft, Delft, The Netherlands

<sup>5</sup>Laboratory of Digital and Computational Demography, Max Planck Institute for Demographic Research, Rostock, Germany

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Francisco Rowe, Geographic Data Science Lab, Department of Geography and Planning, University of Liverpool, Liverpool, UK.  
Email: [frowe@liverpool.ac.uk](mailto:frowe@liverpool.ac.uk)

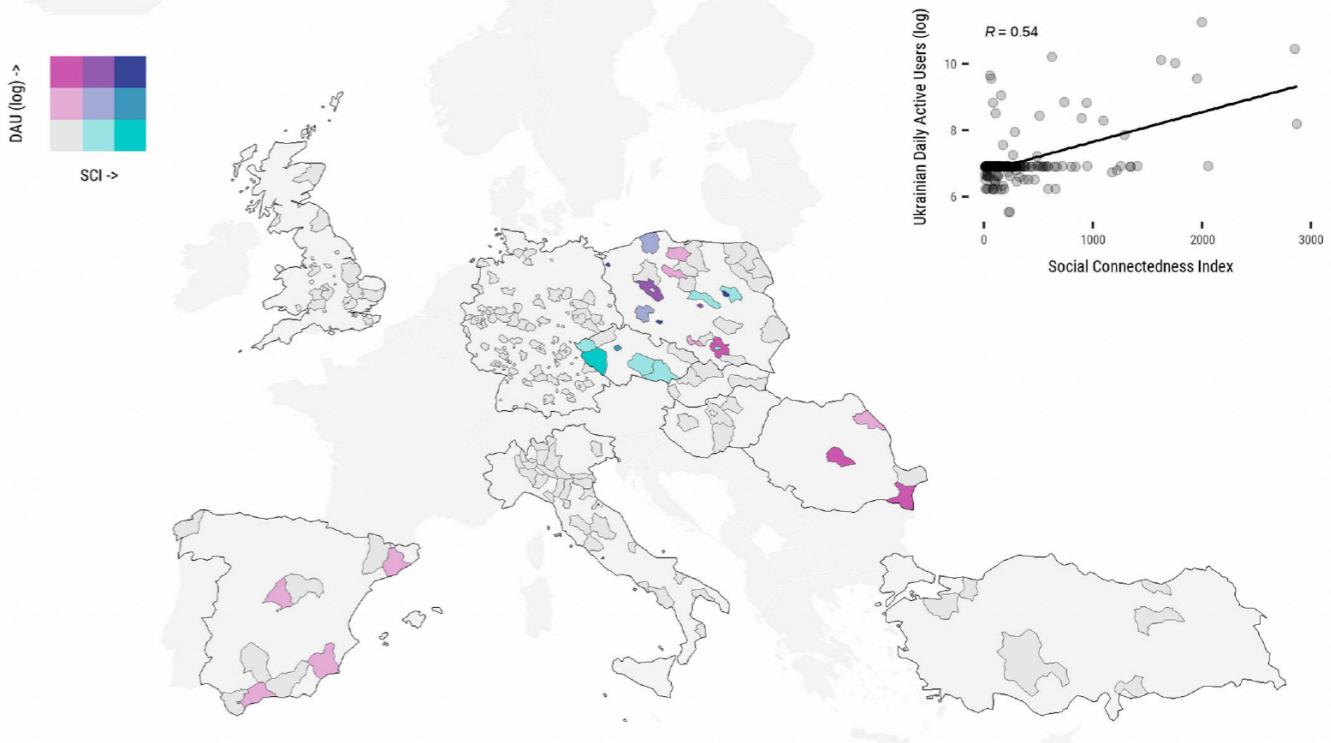
Funding information  
None

#### Abstract

The escalation of conflict in Ukraine has triggered the largest refugee crisis in Europe since WWII. As of early April 2024, over 5.9 million people have fled Ukraine. Large-scale efforts have been made to identify the major receiving countries. However, less is known about the subnational areas within host countries where refugees have migrated. Identifying these areas is key for the appropriate allocation of humanitarian aid. By combining digital Facebook API data and traditional data from Eurostat, this paper aims to identify and characterise potential settlement areas of Ukrainians across the main destination countries in Europe. We identify high concentrations of Ukrainians in urban areas with a preexisting diaspora and tight labour market conditions across southern, northern-west and central Poland and the city of Prague in the Czech Republic. We also find potential settlements in key urban agglomerations with a moderate diaspora and high levels of unemployment in Spain. Only in Romania, refugees seem to have settled in rural areas which show a moderate diaspora but low levels of unemployment. Potential settlement areas in Germany, Italy and the United Kingdom are spread across the country. Surprisingly, we do not identify potential settlement areas in bordering regions with Ukraine within neighbouring countries, suggesting that refugees may have used them as transit points. Our findings point out that different packages of humanitarian assistance may be needed according to the number of refugees and the characteristics of settlement areas.

#### KEYWORDS

Big data, Europe, Facebook data, settlement, Ukrainian refugees



**FIGURE 4** Relationship between Facebook daily active users (DAU) who use Ukrainian as the main language (median from 28 January 2023 to 12 February 2023) and the Facebook social connectedness index (SCI) in August 2020.

# Meta-Facebook Mobility Data

# Data for Good



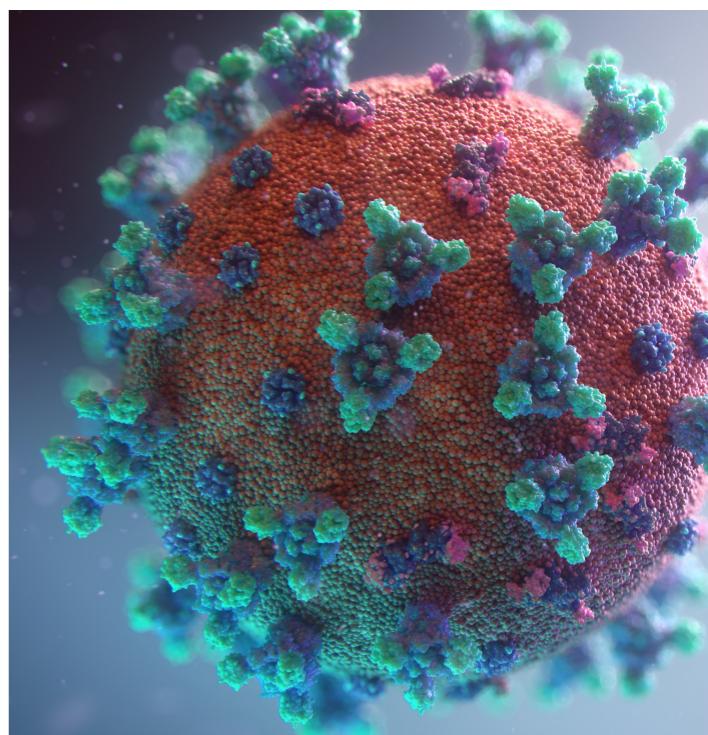
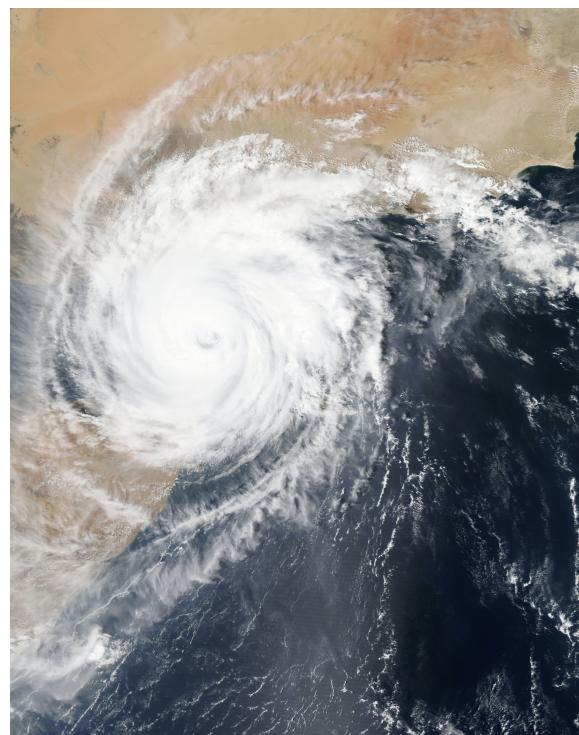
Access to privacy-preserving data for partners to tackle social problems

Data on human mobility during crisis

Two datasets:

Facebook Population  
Movements

Facebook anonymises and aggregates data to preserve users' privacy.



# Movement

**Who?**

Number of Facebook users in different spatial units at two points in time

**Spatial resolution:**

Administration areas

Microsoft Bing Tiles - 2.5-6 Km<sup>2</sup>

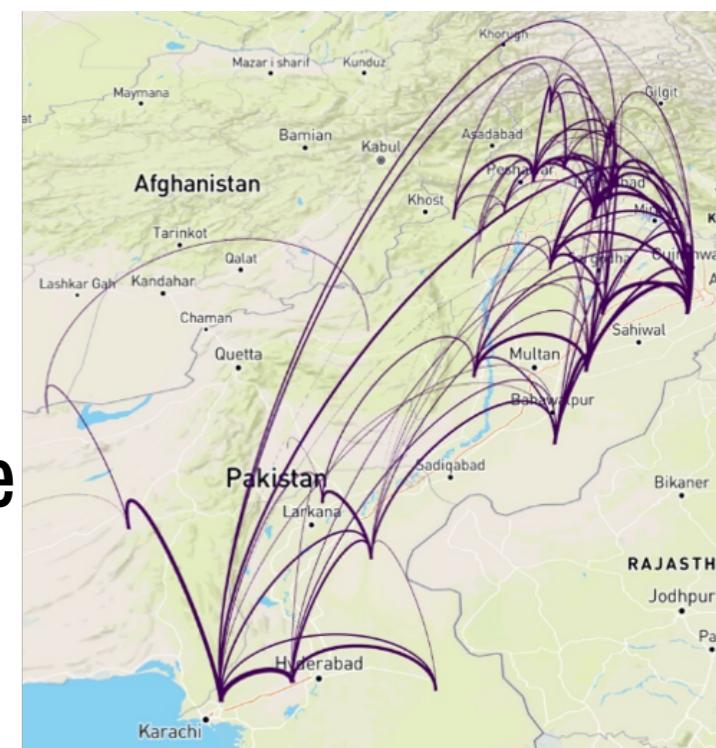
**Near real-time - Time window: 00:00, 8:00 and 16:00 (Pacific Time)**

Comparison of locations where users **spent most time** within each 8-hour window

Period covering the entire event & **baseline period**

No information for units w/ less than 10 obs.

Datasets are discontinued after 90 days after the last data update



Source: Rowe (2022).

dfd4mobility - main - RStudio

mov

Filter

eometry	date_time	start_polygon_id	start_polygon_name	end_polygon_id	end_polygon_name	length_km	tile_size	country	level	n_crisis	n_baseline
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Showing 1 to 29 of 72,973 entries, 23 total columns

Console

dfd4mobility - main - RStudio

mov

Filter

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	LEVEL3	14	16.4	-2.4	-13.7931034		0	-0.747812343	-30.78677	-70.96189	-30.78677	-70.96189	21021323100	21021323100	2020-03-23 04:00:00
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	LEVEL3	91	162.0	-71.0	-43.5582822		0	-2.003380900	-30.78677	-70.96189	-30.78677	-70.96189	21021323100	21021323100	2020-03-23 04:00:00
	LEVEL3	11	13.0	-2.0	-14.2857143		0	-0.816496581	-18.71308	-69.85541	-18.71308	-69.85541	21003312210	21003312210	2020-03-23 04:00:00
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	LEVEL3	460	415.4	44.6	10.7108549		0	1.448311514	-30.78677	-70.96189	-30.78677	-70.96189	21021323100	21021323100	2020-03-23 04:00:00
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	LEVEL3	226	241.0	-5.0	-2.0661157		0	-0.005337592	-35.50740	-71.42570	-35.50740	-71.42570	21023123001	21023123001	2020-03-23 04:00:00

Showing 1 to 29 of 72,973 entries, 23 total columns

Console

# Checking Installation Status

# Software



R



Studio



Quarto



Libraries