Digital Footprint Data for Population Movement

Francisco Rowe
Department of Geography and Planning, University of Liverpool, UK

www.franciscorowe.com
@fcorowe

UNIVERSITY OF LIVERPOOL

Geographic Data Science Lab

Github Repository & Data Access

Link

Descarga del repositorio:
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

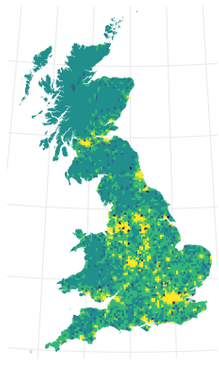
Population inequalities

Individual inequalities

Geographical scale

Local urban mobility

Internal migration



International migration

Impacts

Place inequalities

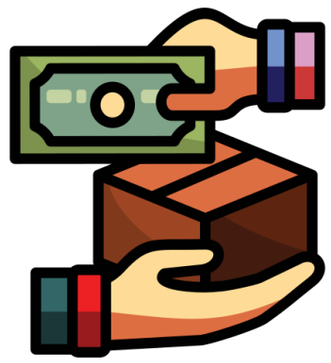
Population inequalities

Individual inequalities

Digital Footprint Data?

Internet

Social media



Commercial & transactional

Sensor

Imagery

Data for Mobility

CDR/XDR

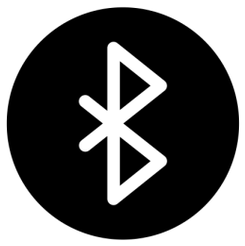
~100m-1km

~30min

GPS

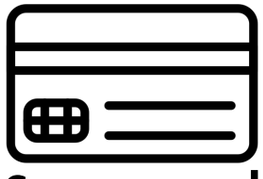
~5-20m

~10-25min



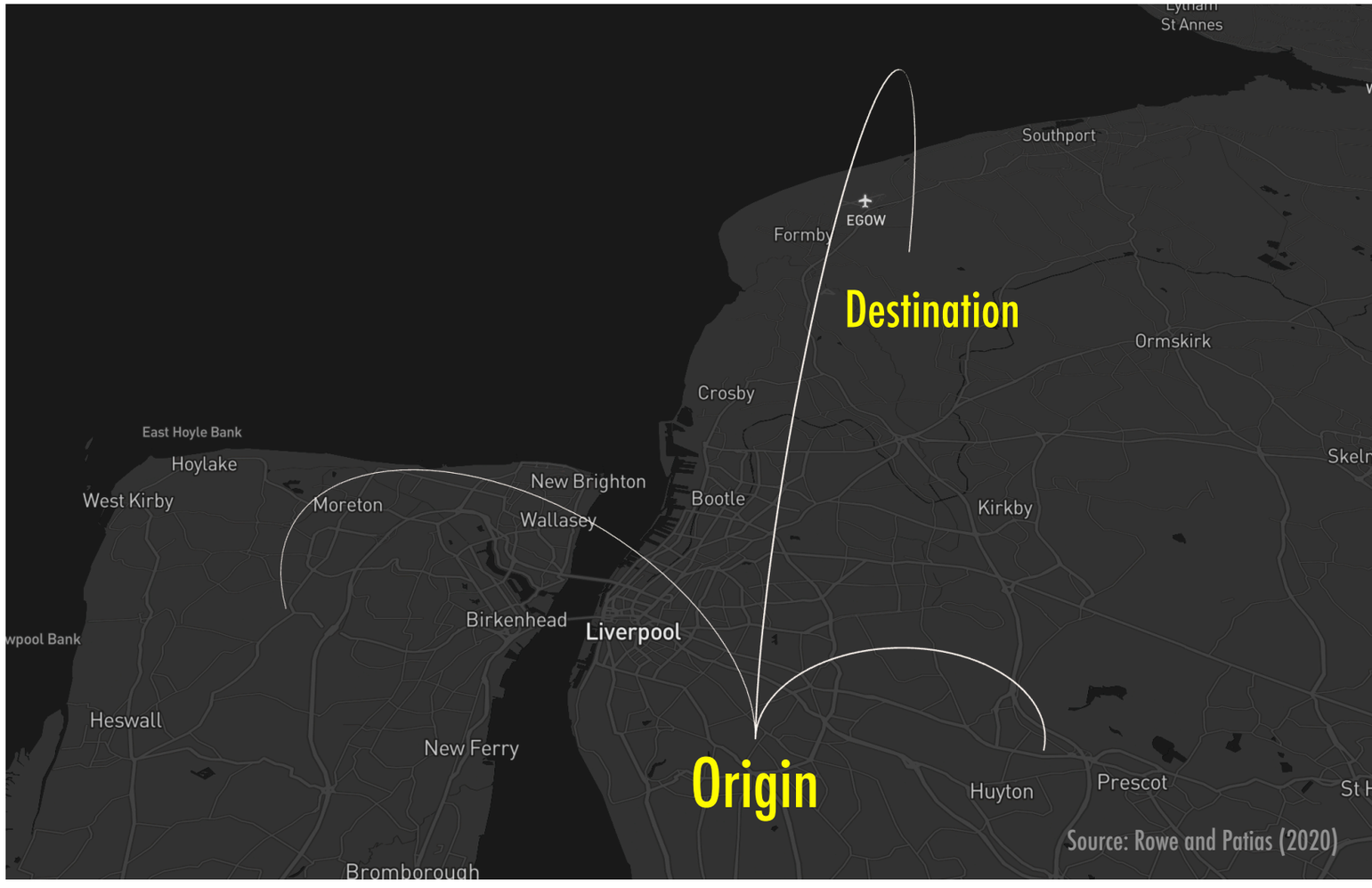
Bluetooth

~1-10m



Smart card

location



Warning **Not** collected for research purposes

Opportunities

High resolution

Geographical and temporal granularity

Contents lists available at ScienceDirect

Transportation Research Part C

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

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

Sui Tao[a,*], Jonathan Corcoran[b], Francisco Rowe[c], Mark Hickman[d]

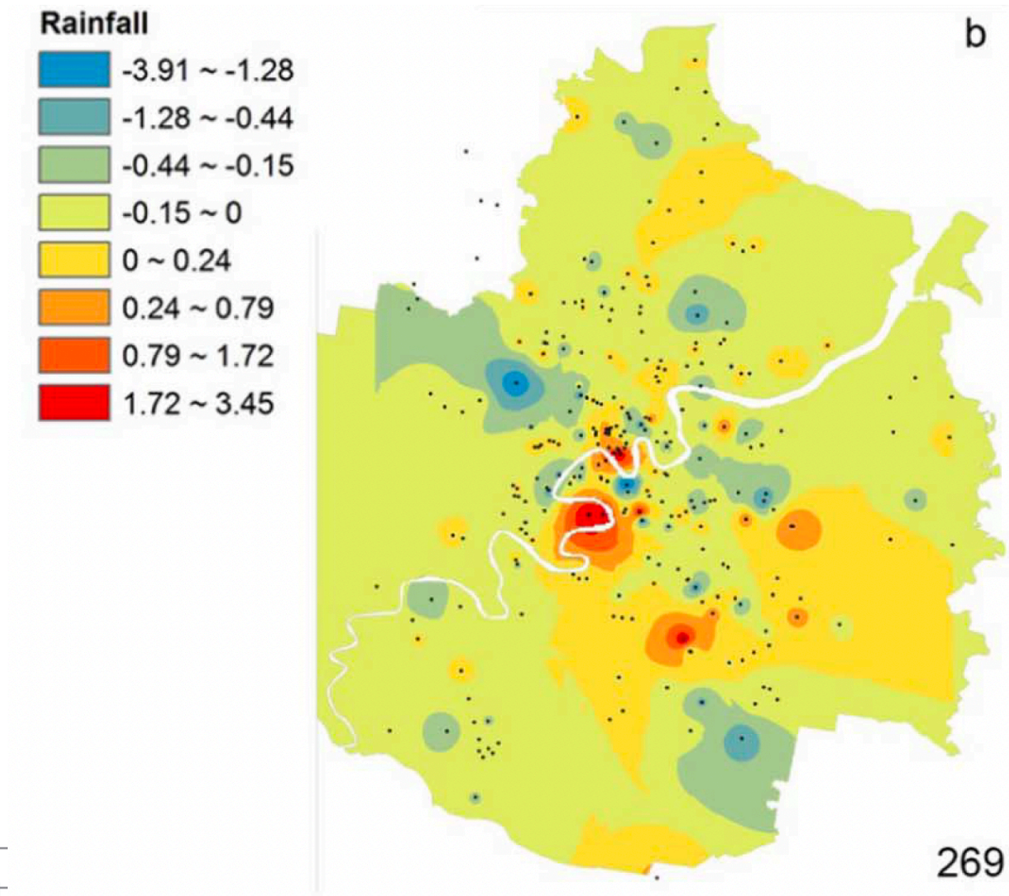
[a] Institute of Future Cities, The Chinese University of Hong Kong, Shatin, New Territories, Hong Kong
[b] School of Earth and Environmental Sciences, The University of Queensland, 4072, Australia
[c] Department of Geography and Planning, School of Environmental Sciences, University of Liverpool, Liverpool L69 7ZT, UK
[d] 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.



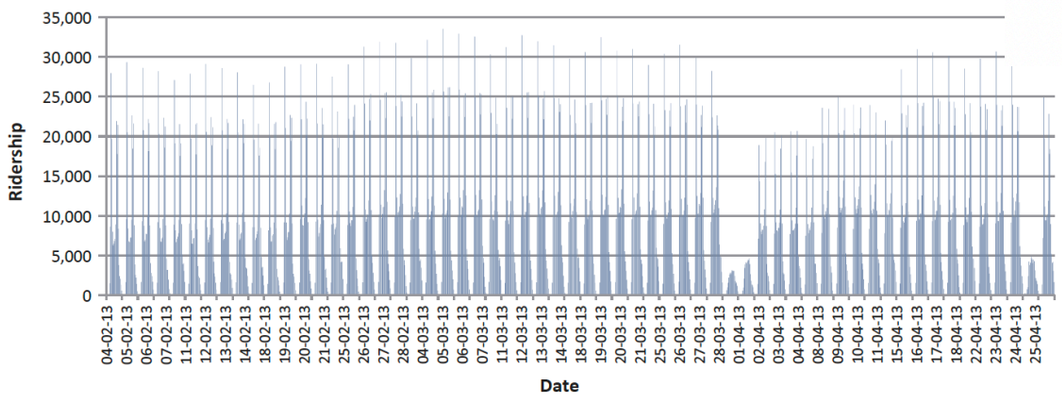


Fig. 6. Weekday hourly ridership.

Greater geographical coverage

Assessing stay-at-home at a global scale

Contents lists available at ScienceDirect

Cities

journal homepage: 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 [a,*], Caitlin Robinson [b], Nikos Patias [a]

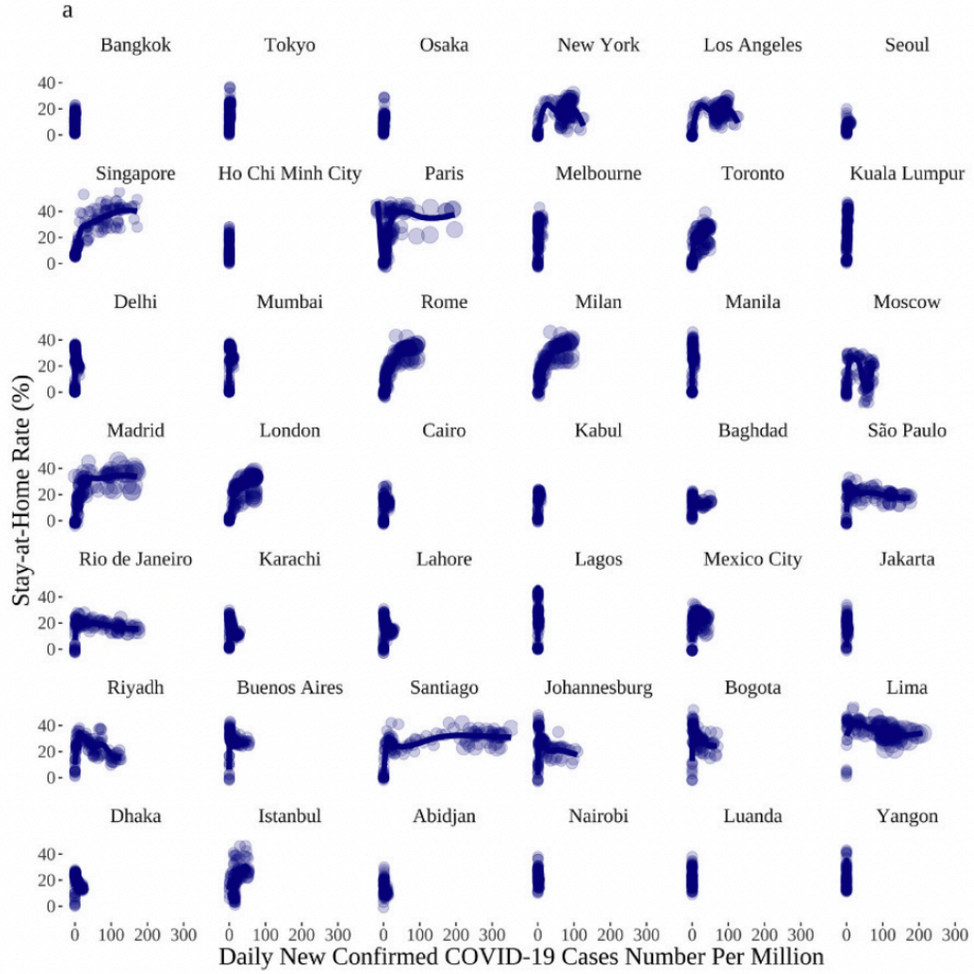
[a] Geographic Data Science Lab, Department of Geography and Planning, University of Liverpool, Liverpool, United Kingdom
[b] School of Geographical Sciences, University of Bristol, Bristol, United Kingdom

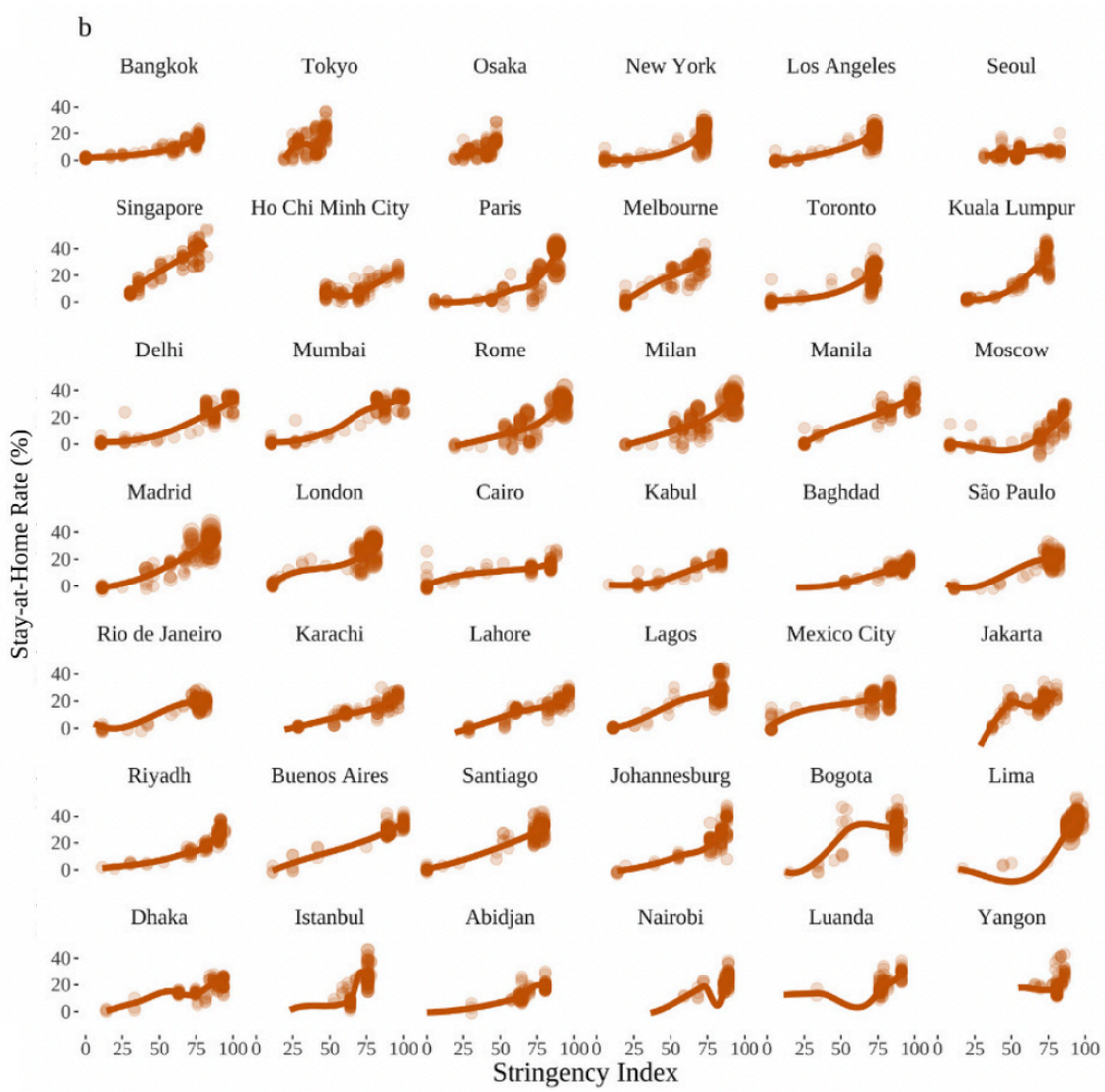
ARTICLE INFO

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

ABSTRACT

COVID-19, and the wider social and economic impacts that a global pandemic entails, led to unprecedented





Near real-time availability

Measuring conflict-induced population displacement

Received: 28 April 2023 | Accepted: 23 April 2024
DOI: 10.1002/psp.2790

RESEARCH ARTICLE

WILEY

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

Miguel González-Leonardo[1,2] | Ruth Neville[3] | Sofía Gil-Clavel[4,5] | Francisco Rowe[3]

[1]Centre for Demographic Urban and Environmental Studies, El Colegio de México, Mexico City, Mexico

[2]International Institute for Applied Systems Analysis, Wittgenstein Centre, Laxenburg, Austria

[3]Geographic Data Science Lab, Department of Geography and Planning, University of Liverpool, Liverpool, UK

[4]Faculty of Technology, Policy, and Management, TU Delft, Delft, The Netherlands

[5]Laboratory of Digital and Computational Demography, Max Planck Institute for Demographic Research, Rostock, Germany

Correspondence
Francisco Rowe, Geographic Data Science Lab, Department of Geography and Planning, University of Liverpool, Liverpool, UK.
Email: fcorowe@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

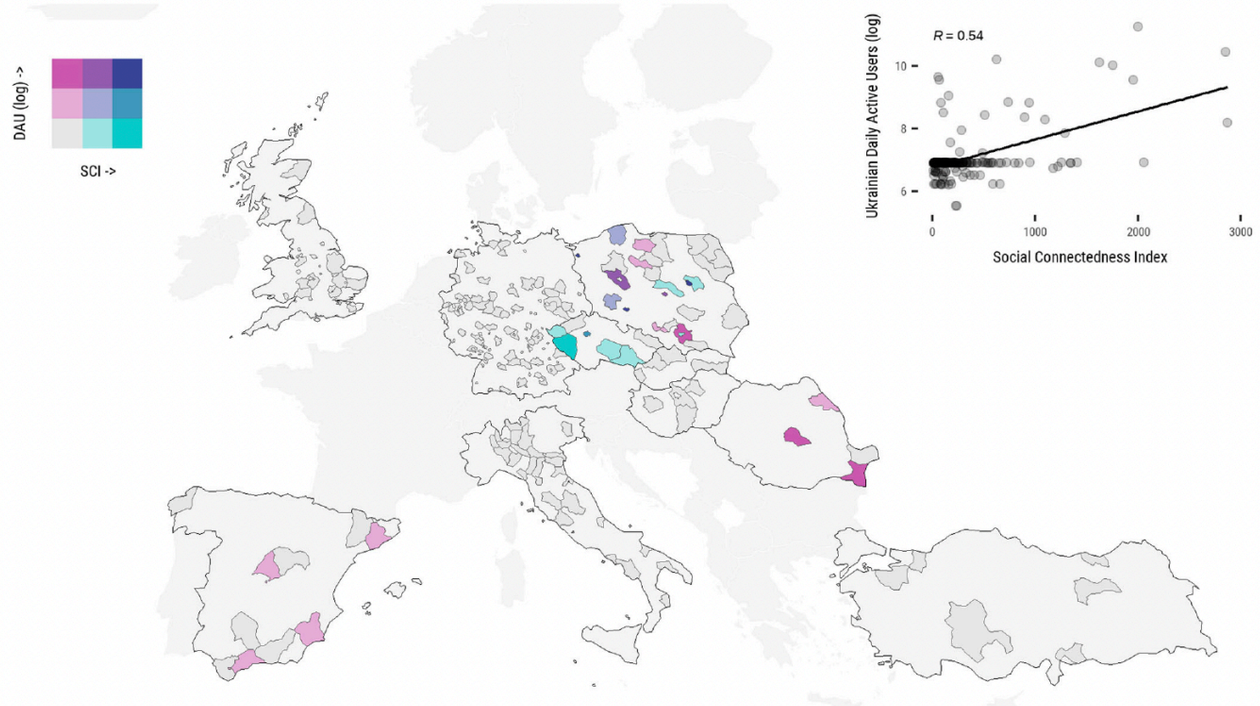


FIGURE 4 Relationship between Facebook daily active users (DAU) who use Ukrainian as the main language (median from 28 January 2023 to 12 February 2023) and the Facebook social connectedness index (SCI) in August 2020.

Meta-Facebook Mobility Data

Data for Good

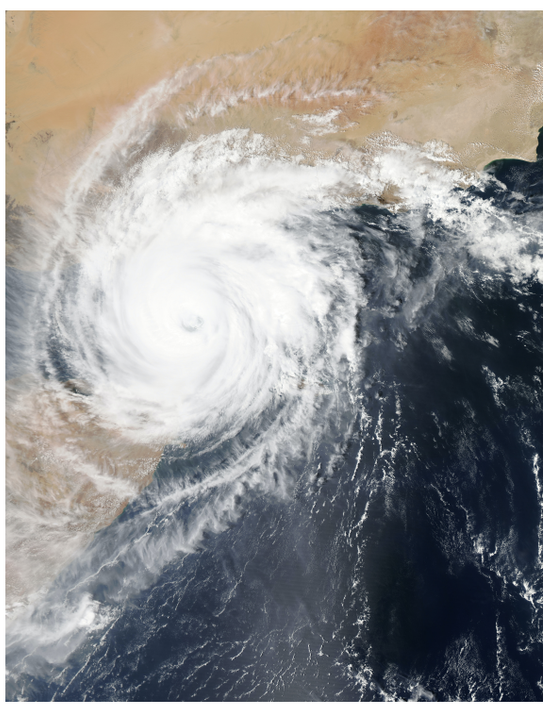
Access to privacy-preserving data for partners to tackle social problems

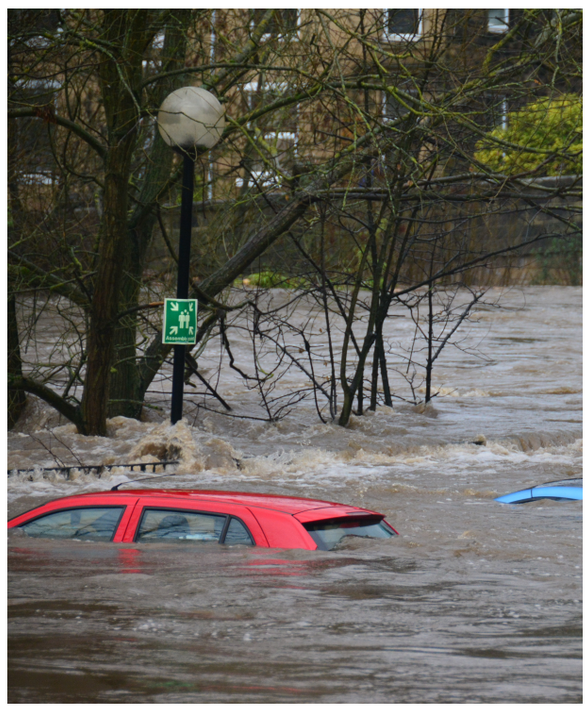
Data on human mobility during crisis

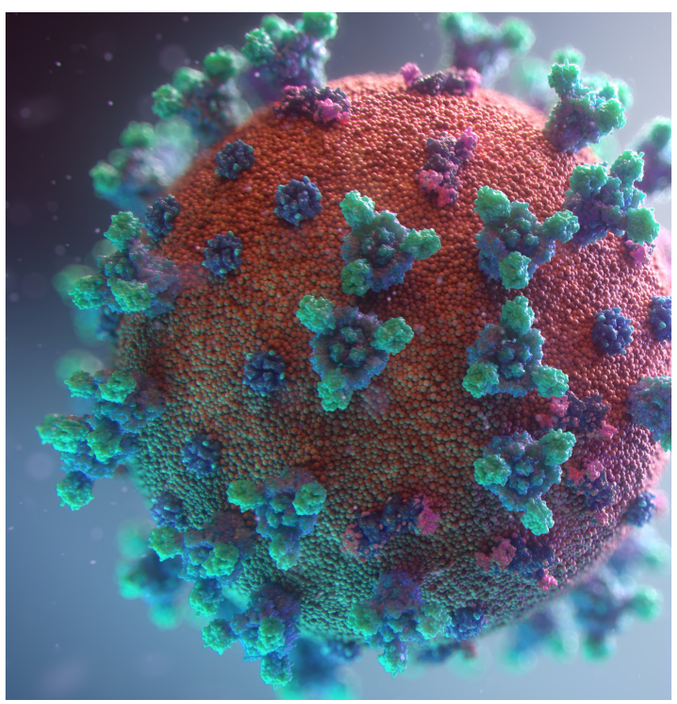
Two datasets:

- 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 Km2

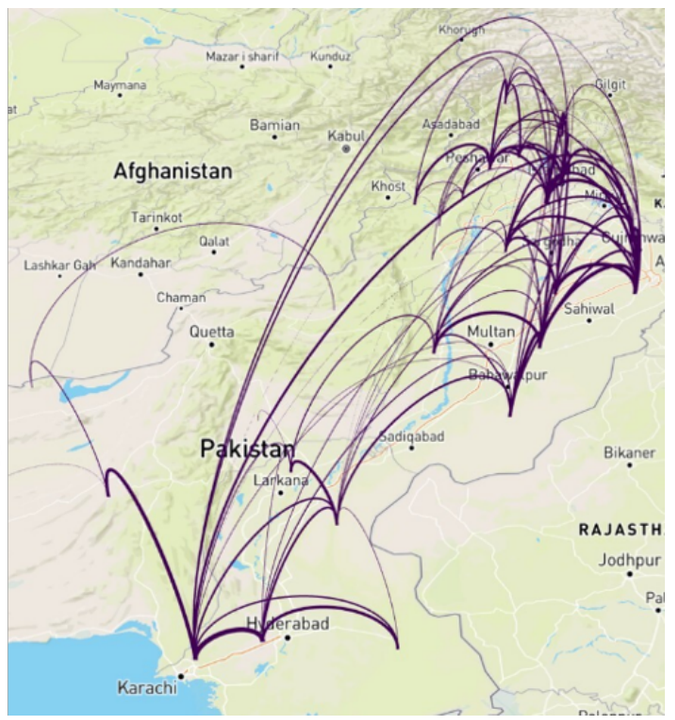
Near real-time - Time window: 00:00, 8:00 and 16:00 (Pacific Time)

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

Go to file/function | Addins | dfd4mobility

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
INESTRING (-72.685546875 -41.83679436036388, ...	2020-03-23 08:00:00	61151	Hualaihué	61151	Hualaihué	0.00000	11	CL	LEVEL4	100	83.6
INESTRING (-71.982421875 -36.66838662873227, ...	2020-03-23 08:00:00	61070	Chillán	61088	San Nicolás	22.19227	11	CL	LEVEL4	44	78.4
INESTRING (-72.333984375 -36.527262572333214...	2020-03-23 08:00:00	61088	San Nicolás	61088	San Nicolás	0.00000	11	CL	LEVEL4	80	58.6
INESTRING (-71.45507812500001 -33.9433287203...	2020-03-23 08:00:00	61219	San Pedro	61219	San Pedro	16.22905	11	CL	LEVEL4	21	14.6
INESTRING (-71.279296875 -33.79737760634471, ...	2020-03-23 08:00:00	61215	Melipilla	61219	San Pedro	16.24293	11	CL	LEVEL4	25	15.6
INESTRING (-71.279296875 -34.23448100875922, ...	2020-03-23 08:00:00	60980	Las Cabras	61219	San Pedro	32.37471	11	CL	LEVEL4	15	11.4
INESTRING (-71.455078125 -34.08903002544869, ...	2020-03-23 08:00:00	60980	Las Cabras	61219	San Pedro	16.20127	11	CL	LEVEL4	15	14.4
INESTRING (-71.455078125 -34.52462999448535, ...	2020-03-23 08:00:00	61002	Palmilla	61006	Santa Cruz	16.08960	11	CL	LEVEL4	52	56.0
INESTRING (-71.279296875 -34.52462999448535, ...	2020-03-23 08:00:00	61002	Palmilla	61006	Santa Cruz	22.75414	11	CL	LEVEL4	19	19.6
INESTRING (-70.927734375 -30.675685824903944...	2020-03-23 08:00:00	60853	Limarí	60853	Limarí	33.62182	11	CL	LEVEL3	14	16.4
INESTRING (-70.224609375 -18.56292709925129, ...	2020-03-23 08:00:00	60894	Arica	60894	Arica	0.00000	11	CL	LEVEL3	8740	7168.6
INESTRING (-71.806640625 -39.300266145437504...	2020-03-23 08:00:00	61105	Pucón	61105	Pucón	15.12543	11	CL	LEVEL4	40	109.2
INESTRING (-70.22460937500001 -18.3962099511...	2020-03-23 08:00:00	60894	Arica	60894	Arica	0.00000	11	CL	LEVEL3	13222	11599.0
INESTRING (-71.103515625 -30.675685824903944...	2020-03-23 08:00:00	60853	Limarí	60853	Limarí	16.82405	11	CL	LEVEL3	26	38.2
INESTRING (-70.751953125 -30.372845781329808...	2020-03-23 08:00:00	60853	Limarí	60853	Limarí	0.00000	11	CL	LEVEL3	17	19.6
INESTRING (-71.103515625 -30.524383776418823...	2020-03-23 08:00:00	60853	Limarí	60853	Limarí	16.82405	11	CL	LEVEL3	28	30.6
INESTRING (-71.630859375 -30.977579345438294...	2020-03-23 08:00:00	60853	Limarí	60853	Limarí	0.00000	11	CL	LEVEL3	18	13.0
INESTRING (-71.279296875 -30.524383776418823...	2020-03-23 08:00:00	60853	Limarí	60853	Limarí	23.79280	11	CL	LEVEL3	12	20.4
INESTRING (-71.982421875 -39.300266145437504...	2020-03-23 08:00:00	61105	Pucón	61105	Pucón	15.12543	11	CL	LEVEL4	20	44.2
INESTRING (-71.806640625 -39.16410803901017, ...	2020-03-23 08:00:00	61105	Pucón	61105	Pucón	21.41136	11	CL	LEVEL4	11	40.2
INESTRING (-70.927734375 -30.675685824903944...	2020-03-23 08:00:00	60853	Limarí	60853	Limarí	0.00000	11	CL	LEVEL3	448	422.2
INESTRING (-71.279296875 -30.675685824903944...	2020-03-23 08:00:00	60853	Limarí	60853	Limarí	16.82405	11	CL	LEVEL3	91	162.0
INESTRING (-70.22460937500001 -18.3962099511...	2020-03-23 08:00:00	60894	Arica	60894	Arica	26.21689	11	CL	LEVEL3	11	13.0
INESTRING (-70.927734375 -30.675685824903944...	2020-03-23 08:00:00	60853	Limarí	60853	Limarí	16.79773	11	CL	LEVEL3	19	23.2
INESTRING (-71.455078125 -30.675685824903944...	2020-03-23 08:00:00	60853	Limarí	60853	Limarí	16.81092	11	CL	LEVEL3	29	39.6
INESTRING (-70.048828125 -18.56292709925129, ...	2020-03-23 08:00:00	60894	Arica	60894	Arica	0.00000	11	CL	LEVEL3	212	175.2
INESTRING (-71.27929687500001 -30.8267512407...	2020-03-23 08:00:00	60853	Limarí	60853	Limarí	0.00000	11	CL	LEVEL3	460	415.4
INESTRING (-71.806640625 -39.16410803901017, ...	2020-03-23 08:00:00	61105	Pucón	61105	Pucón	0.00000	11	CL	LEVEL4	149	293.2
INESTRING (-71.279296875 -30.675685824903944...	2020-03-23 08:00:00	60853	Limarí	60853	Limarí	16.81092	11	CL	LEVEL3	15	16.6
INESTRING (-71.982421875 -35.10190234351262...	2020-03-23 08:00:00	60864	Talca	60864	Talca	0.00000	11	CL	LEVEL3	236	241.0

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

Console

dfd4mobility - main - RStudio

Go to file/function | Addins | dfd4mobility

mov

Filter

ntry	level	n_crisis	n_baseline	n_difference	percent_change	is_statistically_significant	z_score	start_lat	start_lon	end_lat	end_lon	start_quadkey	end_quadkey	date_time2
	LEVEL4	100	83.6	16.4	19.3853428	0	0.828008307	-42.17319	-72.37317	-42.17319	-72.37317	21201102102	21201102102	2020-03-23 04:00:00
	LEVEL4	44	78.4	-34.4	-43.3249370	0	-2.001827814	-36.61352	-72.13239	-36.47571	-72.23225	21023300101	21023122323	2020-03-23 04:00:00
	LEVEL4	80	58.6	21.4	35.9060403	0	0.997454941	-36.47571	-72.23225	-36.47571	-72.23225	21023122323	21023122323	2020-03-23 04:00:00
	LEVEL4	21	14.6	6.4	41.0256410	0	1.034142977	-33.93139	-71.45261	-33.93139	-71.45261	21023103203	21023103203	2020-03-23 04:00:00
	LEVEL4	25	15.6	9.4	56.6265060	0	1.766992214	-33.74376	-71.19374	-33.93139	-71.45261	21023103210	21023103203	2020-03-23 04:00:00
	LEVEL4	15	11.4	3.6	29.0322581	0	1.213559752	-34.16498	-71.33093	-33.93139	-71.45261	21023103232	21023103203	2020-03-23 04:00:00
	LEVEL4	15	14.4	0.6	3.8961039	0	0.526234812	-34.16498	-71.33093	-33.93139	-71.45261	21023103232	21023103203	2020-03-23 04:00:00
	LEVEL4	52	56.0	-4.0	-7.0175439	0	-0.399003734	-34.52852	-71.35123	-34.64358	-71.40013	21023121012	21023121021	2020-03-23 04:00:00
	LEVEL4	19	19.6	-0.6	-2.9126214	0	-0.273861279	-34.52852	-71.35123	-34.64358	-71.40013	21023121012	21023121021	2020-03-23 04:00:00
	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
	LEVEL3	8740	7168.6	1571.4	21.9175407	0	4.000000000	-18.71308	-69.85541	-18.71308	-69.85541	21003312210	21003312210	2020-03-23 04:00:00
	LEVEL4	40	109.2	-69.2	-62.7949183	0	-3.220521162	-39.27581	-71.78953	-39.27581	-71.78953	21023320133	21023320133	2020-03-23 04:00:00
	LEVEL3	13222	11599.0	1623.0	13.9913793	0	4.000000000	-18.71308	-69.85541	-18.71308	-69.85541	21003312210	21003312210	2020-03-23 04:00:00
	LEVEL3	26	38.2	-12.2	-31.1224490	0	-1.936264028	-30.78677	-70.96189	-30.78677	-70.96189	21021323100	21021323100	2020-03-23 04:00:00
	LEVEL3	17	19.6	-2.6	-12.6213592	0	-0.453979692	-30.78677	-70.96189	-30.78677	-70.96189	21021323100	21021323100	2020-03-23 04:00:00
	LEVEL3	28	30.6	-2.6	-8.2278481	0	-0.390635299	-30.78677	-70.96189	-30.78677	-70.96189	21021323100	21021323100	2020-03-23 04:00:00
	LEVEL3	18	13.0	5.0	35.7142857	0	1.250000000	-30.78677	-70.96189	-30.78677	-70.96189	21021323100	21021323100	2020-03-23 04:00:00
	LEVEL3	12	20.4	-8.4	-39.2523364	0	-1.434274331	-30.78677	-70.96189	-30.78677	-70.96189	21021323100	21021323100	2020-03-23 04:00:00
	LEVEL4	20	44.2	-24.2	-53.5398230	0	-2.693882187	-39.27581	-71.78953	-39.27581	-71.78953	21023320133	21023320133	2020-03-23 04:00:00
	LEVEL4	11	40.2	-29.2	-70.8737864	0	-3.602468290	-39.27581	-71.78953	-39.27581	-71.78953	21023320133	21023320133	2020-03-23 04:00:00
	LEVEL3	448	422.2	25.8	6.0964083	0	1.415532653	-30.78677	-70.96189	-30.78677	-70.96189	21021323100	21021323100	2020-03-23 04:00:00
	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
	LEVEL3	19	23.2	-4.2	-17.3553719	0	-0.881528508	-30.78677	-70.96189	-30.78677	-70.96189	21021323100	21021323100	2020-03-23 04:00:00
	LEVEL3	29	39.6	-10.6	-26.1083744	0	-1.649418417	-30.78677	-70.96189	-30.78677	-70.96189	21021323100	21021323100	2020-03-23 04:00:00
	LEVEL3	212	175.2	36.8	20.8853575	0	2.407234852	-18.71308	-69.85541	-18.71308	-69.85541	21003312210	21003312210	2020-03-23 04:00:00
	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
	LEVEL4	149	293.2	-144.2	-49.0142760	0	-0.772369723	-39.27581	-71.78953	-39.27581	-71.78953	21023320133	21023320133	2020-03-23 04:00:00
	LEVEL3	15	16.6	-1.6	-9.0909091	0	-0.447213595	-30.78677	-70.96189	-30.78677	-70.96189	21021323100	21021323100	2020-03-23 04:00:00
	LEVEL3	236	241.0	-5.0	-2.0661157	0	-0.095337592	-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

Source: Rowe (2022).