# Using Digital Trace Data to Monitor Human Mobility and Support Rapid Humanitarian Responses*

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**Abstract**

Global warming is increasing the frequency of extreme weather events leading to an increased risk of large-scale population displacements. Since June 2022, Pakistan has recorded destructive flash flooding resulting from melting glaciers and torrential monsoon rainfall. Emergency responses have documented flood-related deaths, injuries and infrastructure, less is known about population displacements resulting from recent floods. Information on these populations and mobility is critical to ensure the appropriate delivery of humanitarian assistance where it is most needed. Lack of granular spatial data in real time have been a key barrier. This article uses digital footprint data from Meta-Facebook to identify the patterns of population displacement in Pakistan in near real time.

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Global warming is increasing the frequency of extreme weather events, natural disasters and large-scale population displacements. Pakistan is a current example of such events. Since June 2022, Pakistan has suffered destructive flash flooding. As of 3 September 2022, a third of the country was estimated to be underwater (Scarr, Katakam, and Gopalakrishnan 2022). Pakistan has the largest number of glaciers outside polar regions and higher temperatures have led to excess of water from melting ice in the Himalayas. Sudden outbursts of melting glacier water, coupled with torrential monsoon rainfall and long-term deforestation, have thus contributed to landslides, floods and the overflowing of the the Indus River which stretches 2,880 km across Pakistan from north to south. Since June 2022, 33 million people are estimated to have been affected, over 1,500 killed and over 6,000 injured as a result of damaged or collapsing housing and public infrastructure (Scarr, Katakam, and Gopalakrishnan 2022). The southern-eastern province of Sindh is the worst affected area (Scarr, Katakam, and Gopalakrishnan 2022).

The scale of the humanitarian crisis is anticipated to be unprecedented. Floodwater have swept away infrastructure, crops, livestock and livelihoods. Limited agricultural production is likely to add pressure to the existing cost of living crisis due to post-pandemic supply chain disruptions and ongoing war in Ukraine (Aminetzah et al. 2022). Additionally, waterborne diseases are expected to start spreading in the coming weeks. Dengue cases have already began soaring following record floods in August (Fihlani 2022). Shelter, clean drinking water and food are urgently needed items in Pakistan.

Geographically granular data in real time are critical to monitor population displacement and support the provision of humanitarian aid where it is needed (Rowe, Neville, and González-Leonardo 2022) . Traditional data systems are not regularly updated, costly and characterised by slow data collection and release (Green, Pollock, and Rowe 2021) . We use digital footprint data to capture population movements in near-real time. Specifically, we use spatially aggregate, privacy-preserving location history data from Facebook users to identify changes in local population (Figure 1 during 13 August-7 September 2022 and human mobility patterns (Figure 2 (b)) on 15 August the day Pakistan declared a state of emergency. Percentage changes in population correspond to the difference between day-specific populations and a baseline period. The baseline period covers 45 days going back 12 August.

Figure 1 reveals a persistent pattern of population decline in areas along the Indus River. Declines in these areas exceed 20 percent of the Facebook population during the baseline period. Figure 1 also suggests that people started leaving areas in Sindh from 18 August. Northern-eastern areas of the Indus River record less pronounced population changes, while southern areas of Balochistan showed population increases, particularly since 25 August. Figure 2 (b) reveals central nodes of departure reflecting people moving away from towns and cities along the Indus River, and large numbers moving to Islamabad from neighbouring areas in the north of the country. The figures presented here offer an illustrative example of the potential of digital footprint data to support rapid humanitarian responses and ensure the delivery of assistance where it is needed. At the same time, I emphasise a need to carefully considered the methodological and ethical challenges relating to biases, representation

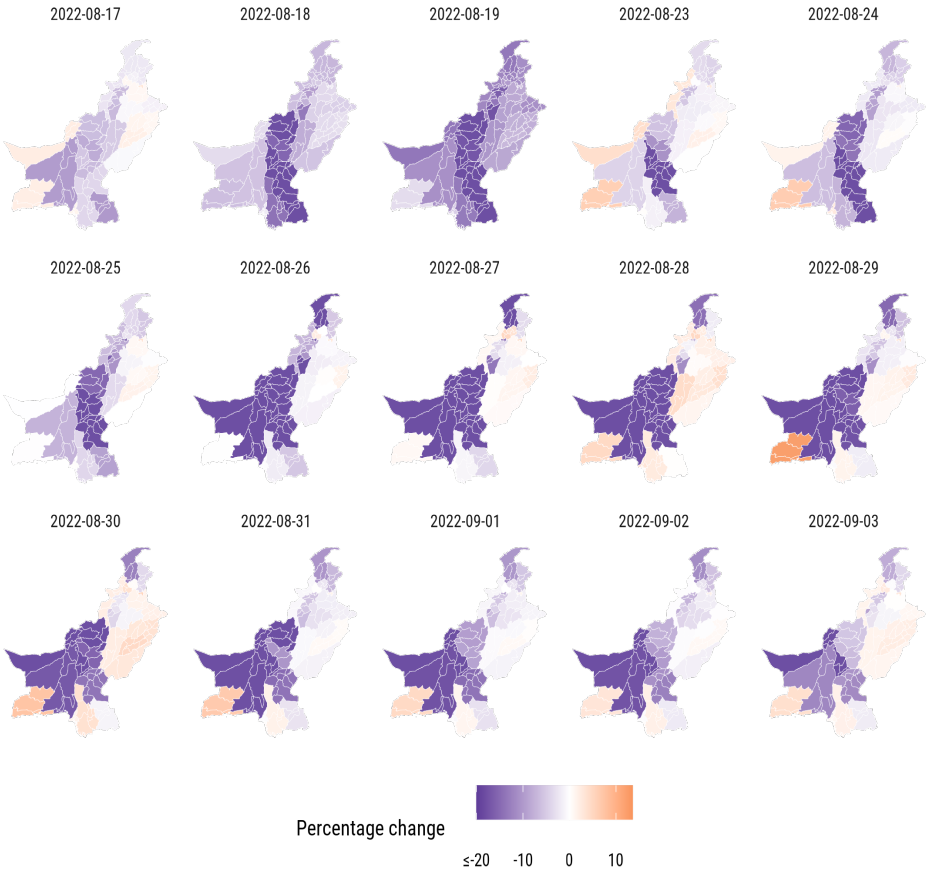


Figure 1. Percentage population change (Source: Facebook Data For Good).

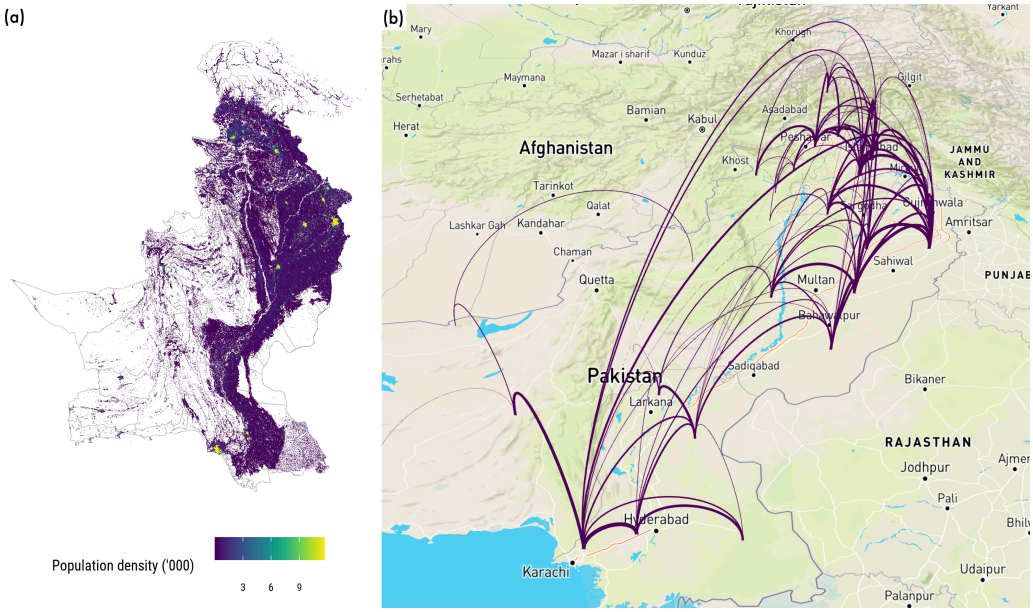


Figure 2. (a) Population density (Source: Global human settlement layer). (b) Human mobility flows 15 August (Source: Facebook Data For Good).

and privacy of these data as they have not been purposely build for academic research (Rowe 2021).

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