



Mobile Phone Usage Data for Disaster Response

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SEVERE DISASTERS CAN cause large population movements as affected people are displaced from their residences. The humanitarian response to such events relies on understanding where affected people are located. Mobility data can provide important insights at all stages of a crisis, from preparedness to long-term recovery.

At Flowminder, a non-profit foundation based in Sweden, the U.K., and Switzerland, we are working to support decision-makers to transform the lives of vulnerable people by facilitating access to novel sources of mobility data, including Call Detail Records (CDRs). Across Europe, non-profits, national statistical services, academic institutions, and mobile network operators (MNOs), including Orange, Telefonica, Telenor, and Vodafone, are collaborating on using CDR to support public policy. Additionally, the European Commission established the High-Level Expert Group on Business-to-Government Data Sharing to support such collaborations, including in response to the COVID-19 pandemic.⁹

The global spread of mobile devices provides new opportunities for better understanding mobility and addressing mobility data gaps. The International Telecommunication

Union estimates that 92% of the global population, including 89% of people in Least Developed Countries (LDCs), have mobile network coverage with 105 mobile-cellular telephone subscriptions per 100 people globally, and 74 subscriptions per 100 people in LDCs.⁵ However, mobile device penetration remains substantially lower in many vulnerable populations.

CDRs are routinely produced by MNOs for billing purposes each time a subscriber makes or receives a call, sends or receives a text message, or uses mobile data ("network events"). Each record contains the time of the event and

the cell site it was routed through, thereby describing subscribers' movements. By pseudonymizing and aggregating CDR data over large numbers of subscribers, practitioners produce mobility indicators that provide insights into the overall movement of the population while preserving individual privacy. Furthermore, because this data is collected in near-real time, indicators can be calculated within days to aid the response to ongoing crises.

CDRs have been used to support responses to natural disasters in Low-to-Middle Income Countries (LMICs), including Bangladesh,⁸ Haiti^{1,7} (see Figure 1), Nepal¹²

and Vanuatu.⁶ It has a range of applications in disaster management, including dynamic population mapping and calculating flows between locations. These indicators reveal important information throughout a disaster, such as the number of people who may be affected by a disaster, the number complying with evacuation orders, the origins, and destinations of internally displaced people (IDPs), and the return of IDPs to their pre-disaster residence (see Figure 2).

Flowminder's analysis of three disasters in Haiti and Nepal,² and confirmed for other disasters,¹³ has shown a consistent decay rate in the

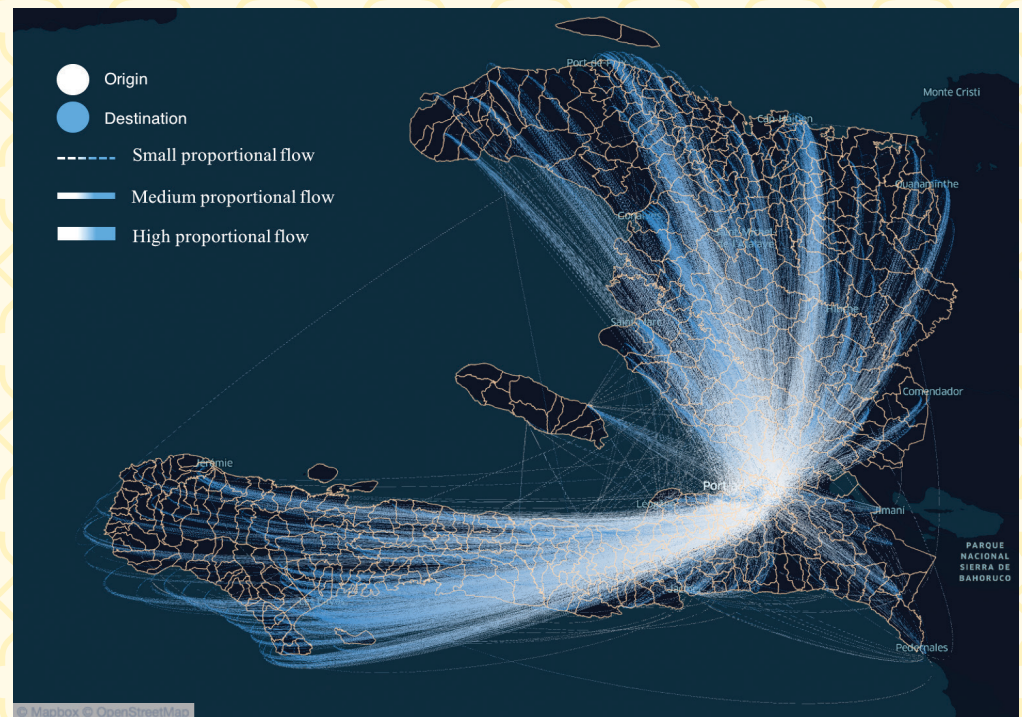


Figure 1. The displacement of people from Port-au-Prince in the aftermath of the 2010 Haiti earthquake (CDRs from Digicel Haiti).

number of IDPs remaining displaced post-disaster. This allowed Flowminder to forecast the remaining numbers of IDPs after the 2021 Haiti earthquake to help inform long-term planning.

CDRs can also improve predictions of displacement location. Modeling by Flowminder has shown that more localized travel and social contacts are associated with individuals being displaced in the vicinity of their pre-disaster residence, regardless of disaster intensity and local property damage.² Such models can support disaster preparedness, including simulations and exercises, and impact prediction.

Mobile phone subscribers are not, however, representative of the population, especially in LMICs. Subscriptions and usage vary with factors including gender, age, education, and socioeconomic status.¹¹ This is of particular concern for humanitarian use cases, compared to commercial applications, as it


may result in the impact of disasters on potentially vulnerable groups under-represented in the data being underestimated. Flowminder is developing methods for addressing these limitations, including gender-disaggregated indicators in Nepal³ and the collection of survey data in the Democratic Republic of Congo and Ghana.

Preserving individual privacy presents another challenge. CDRs contain the movement patterns of individual subscribers, though these are never shared. To ensure anonymity, Flowminder and other practitioners provide aggregates describing the mobility of large numbers of subscribers. While trajectories might be inferred from high-resolution aggregates, real-world datasets, and particularly those from LMICs, are resistant to re-identification attacks.¹⁰

Expediting the production of indicators to provide rapid, up-to-date informa-

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tion to decision-makers is also a key challenge. Partnerships in countries frequently impacted by natural disasters, such as between the GSMA and TuckCell in Turkey,⁴ can facilitate this as access to data has already been agreed and implemented. Following the 2021 earthquake, Flowminder's existing partnership with Digicel Haiti enabled the release of a report just six days after the earthquake. Flowminder is also supporting MNOs to establish streamlined technical and administrative processes through projects like FlowKit and OPAL, to facilitate the timely production of mobility indicators.

CDR-derived mobility indicators can provide rapid, near real-time insights before, during, and after a disaster, when understanding population movements and mobility is important to the efficient provision of aid. There remain important areas for further improvement of these tools to expedite the dissemination of the indicators and to address the biases in CDR data. Regardless, such indicators are immensely valuable to decision making, especially during a disaster when high-quality data is limited. 

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Preparedness (Baseline)	How many people live within phone coverage areas?
	How many active subscribers are there per region per month?
	How many people could be reached via mobile phones?
Hazard forecast	How many people may be affected?
Hazard warning	Are people moving or relocating as the results of warnings?
Active crisis with network outage	Have cell towers been damaged?
Active crisis	How many subscribers are displaced, from where to where?
Short-term recovery	Are subscribers returning to their home or staying at their displaced locations, and how long does it take (in terms of weeks)?
Long-term recovery	Are resettlement areas growing or depleting over time (in terms of months, years)?

Figure 2. The applications of CDR-derived mobility indicators over the course of a humanitarian crisis.