Haiti (cholera)

Mobility across regions used as inputs for Cholera outbreak analysis following the Haiti 2010 earthquake (Bengtsson et al., 2011)

Background

Haiti was struck on the 12th of January 2010 by a devastating earthquake that rapidly triggered population movements out of the capital Port-au-Prince, severely affected by the disaster. Needs assessment and coordination of the relief effort were made difficult by the lack of reliable estimates of the actual displacements of the population.

On the 21st of October of the same year, an outbreak of cholera, which was the first in the country for more than a century, was confirmed in several communes around the city of St Marc. Authorities and relief agencies feared that a large number of people would be leaving the area where the outbreak was first declared, thereby increasing the risk of quickly spreading the disease to other areas of the country.

This use case demonstrated the value of mobile network data to estimate population movements in both situations. First, analysis of Digicel SIM cards positioning estimated that approximately 630,000 people had left Port-au-Prince within 19 days following the earthquake and spread across the rest of the country with destinations matching closely the results of a UN retrospective population-based survey. Second, data analysis of SIM cards location could be performed within 12 hours of receiving the data from Digicel to identify the destination of SIM cards moving out of the outbreak onset area, therefore, identifying where cholera may spread first.

Insights on this approach

This use case highlights the potential for mobile phone data analysis to estimate population movements following a disaster to better distribute geographically a relief response. It also demonstrates that once relationships with mobile phone operators are established and SIM cards data can be retrieved and processed, identifying geographical priorities for outbreak response and preparedness can be done within hours.

Key steps taken for producing statistics

 Filtering

For estimating movements out of Port-au-Prince, only SIM cards with at least one call within 42 days before the earthquake and at least one call in the last 30 days of the follow-up period post-earthquake (158 days) were included in the analysis. This ensured that SIM cards inactivated during the earthquake and new SIM cards belonging to the large number of relief workers arriving in the country post-disaster were excluded. For estimating movements from the outbreak area, all SIM cards with at least one call registered in the outbreak area within the study period (October 15th to October 23rd, 2010).

Geographical location

Daily location of SIM cards was chosen as the location of the cell tower through which the first phone call of the day was made from the SIM card. Cell towers locations and coverage areas were provided by Digicel and overlaid with administrative boundaries (department, commune, and communal section) and population layers for 2009.

Population estimates out of Port-au-Prince

The ratio of persons per SIM card in Port-au-Prince (3.2 persons per SIM card) was estimated from the number of active SIM cards on the day of the earthquake and the total population of the city. It was then assumed that each SIM card movement represented that of 3.2 persons.

Comparison with UN population-based survey

The survey was conducted in 2,500 households in Port-au-Prince in September 2010 and recorded whether households members left Port-au-Prince after the earthquake, even for a short duration, and where they went. To match this survey methodology as closely as possible, a sub-analysis was run on SIM cards that were present in Port-au-Prince the day of the earthquake and had returned to Port-au-Prince by the end of the study period (mid-June 2010). To account for the unspecified duration spent out of Port-au-Prince in the survey question, analysis on SIM cards location was run for two durations outside of Port-au-Prince: at least 2 days and at least 7 days.

Areas of improvement and challenges
Lower mobile phone use amongst specific groups in the population (children, elderly, women, poorest households) can result in a bias and SIM card movements that do not represent movement of these groups. Good agreement between results derived from SIM cards movements and survey data suggest however that movement patterns between subscribers to those SIM cards and other population groups were not differing significantly.

Low cell tower coverage in some areas of the country may have led to inaccuracies in SIM cards location. Similarly, the change of location of infrequent callers will be less accurately timed.

The earthquake damaged the mobile phone network capacity only for a few days, but the power supply infrastructure was more severely affected. Difficulties for people to charge their phone may have biased the results. However, the unreliability of the power supply before the disaster may have prepared owners to save battery by switching off their phone between calls and using devices with long battery life.