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Internal Population Displacement in Haiti

Preliminary analyses of movement patterns of Digicel mobile phones: 1 December 2009 to 19 December 2010

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Executive summary

We analyzed data on the locations of all Digicel mobile phones in Haiti before and after the 12 January 2010 earthquake. This report is an update of earlier reports and covers the period 1 December 2009 to 19 December 2010.

Port-au-Prince area:

The earthquake caused a strong outflow of phones from Port-au-Prince. There was a strong net inflow back to the Port-au-Prince metropolitan area from the beginning of February until early May. From this time onwards, the net inflow decreased and population levels became relatively stable at the end of the analysis period (19 December).

Departments:

A net outflow of phones took place from February in all departments outside Port-au-Prince. The outflow slowed after May. During the rest of the year the net increase of phones in the departments was relatively stable

Return to Port-au-Prince of the people who had left

68% of mobile phones located in Port-au-Prince at the time of the earthquake and that had left Port-au-Prince by 31 January, had returned by 19 December.

A. Introduction

Reports[1] described large population movements in Haiti following the Jan 2010 earthquake. The magnitude and trends of such population movements are important to efficient relief operations. In addition, such estimates provide essential information to design and interpret results of needs assessment surveys.

Our research team from the Division of Global Health/Department of Public Health Sciences at Karolinska Institutet in Sweden and Columbia University in the U.S. has in collaboration with Digicel Haiti analyzed data on movements of SIM cards from the Digicel Haiti mobile phone network to estimate population movements following the earthquake. The analyses cover the period from 1 December, 2009 to 19 December, 2010. By making these preliminary analyses available we aim to support the ongoing recovery efforts in Haiti. We are currently working on in-depth analyses and comparisons with other surveys of population movements in Haiti.. The data presented here is thus work in progress and should not form the basis for policy decisions outside Haiti.

Section one of this report shows the daily number of SIM cards in the Port-au-Prince metropolitan area during the 384 day-period. Section 2 tracks the increase of SIM cards over time within each of the 10 departments of Haiti. Section three analyzes the composition and movements of sub-groups of mobile phones and includes a population estimate of Port-au-Prince inhabitants in the 10 departments. This report supersedes analyses included in earlier reports.

B. Methods

We analyzed location data of all Digicel SIM cards (henceforward used interchangeably with the term “mobile phone” or “phone”) between 1 December, 2009 to 19 December 2010. Locations were registered at the first call from each phone, each day. We based the estimates on the subset 1.8 million SIM cards that had made at least one call during 1 December, 2009 to 11 January, 2010 (pre-earthquake period) and at least one call during 1 December to 19 December, 2010. Analyses do thus not include SIM cards first registered after the earthquake, nor SIM cards that were destroyed or otherwise became inactive during the analysis period. The population estimates used derive from official population estimates for the year 2009.[2]

The geographic locations of mobile phones refer to the location of the cell phone towers to which the phones connected when calling. The data thus allows for locating a mobile

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[1] OCHA. Haiti Earthquake - Population Movements out of Port-au-Prince - 17 February 2010. http://www.reliefweb.int/rw/rwb.nsf/db900sid/AMMF-82SVUA?OpenDocument&query=population%20movement&emid=EQ-2010-000009-HTI. Retrieved 11 May 2010.
OCHA. Haiti Earthquake - Population Movements out of Port-au-Prince - 8 February 2010. http://www.reliefweb.int/rw/rwb.nsf/db900sid/MNIN-82GQYS?OpenDocument&query=population%20movement&emid=EQ-2010-000009-HTI. Retrieved 11 May 2010.

[2] Population totale, population de 18 ans et plus menages et densités estimés en 2009. March 2009. Institut haïtien de statistique et d’informatique. http://www.ihsi.ht/produit_demo_soc.htm. Retrieved 11 May, 2010.

phone within an area of a few square kilometers. No individual can be identified from the data. The analysis team has only have access to anonymized data.

Area definitions are based on the official Haitian administrative system, with the exception of the Port-au-Prince metropolitan area[3] (henceforward “Port-au-Prince”), which is defined in the appendix. When reference is made to the department “Ouest”, this area always excludes the Port-au-Prince area.

The movements of mobile phones is an exact measure and is clearly defined. However, not all people in Haiti have a mobile phone. Approximately half of all 15-59 year-old persons in Port-au-Prince own a Digicel SIM card and use it for regular phone calls. Outside Port-au-Prince, this figure is lower.

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C. Caveats

The extent to which the mobile phone movement patterns can represent the movements of people without a mobile phone is not known. In general, movement trends (shapes of the curves) are likely to be a better predictor of reality than point estimates of population numbers for specific days. If people without a mobile phone have very different population movement patterns compared to people with a mobile phone, the biases in these estimates could be large. For further interpretation of the information in this preliminary report, please contact the authors.

[3] See appendix for definition

D. Results

1. Mobile phones in Port-au-Prince

Figure 1 below shows the relative changes in the number of mobile phones in Port-au-Prince between 1 December, 2009 and 19 December, 2010. The vertical axis shows, for each day, the change in total number of mobile phones in percent compared to the number of phones present in Port-au-Prince on 21 December (820,000 phones). 21 December is chosen as a reference point since this was the most recent day before the earthquake at which population movements were stable and low. As an example on how to read the figure, there was (due to migration) on 31 January 23% less phones in Port-au-Prince than on 21 December.

Five phases of net mobile phone movement in and out of the Port-au-Prince metropolitan area can be seen:

Phase 1 (1-20 Dec): Stable period. The net movement in and of Port-au-Prince were small

Phase 2 (21 Dec-11 Jan): A net out-migration from Port-au-Prince was followed by a similar net in-migration. This pattern was likely caused by people leaving Port-au-Prince to celebrate Christmas and New year. At the time of the earthquake (12 Jan), most, but not all phones, had returned to to Port-au-Prince.

Phase 3 (12-31 Jan): A large net out-migration followed the earthquake. On 31 January, the number of mobile phones in the city was 23% lower than on 21 December, 2009.

Phase 4 (1 Feb-30 April): A stable and linear increase of the number of phones took place, primarily due to a return of the phones that left Port-au-Prince following the earthquake.

Phase 5 (1 may-mid Aug): The net inflow of phones into Port-au-Prince metro area continued but the net daily inflow decreased (the curve flattens off). On 15 Aug. there were 6.6% less phones in the Port-au-Prince metro area than on 21 December, 2009

Phase 6 (mid Aug-early Oct): A small net-outmigration was followed by a slow net in-migration into Port-au-Prince during the late summer. The net number of phones in Port-au-Prince returned to the mid August level at the beginning of the period, around the time of most schools starting (4 October).

Phase 7 (early Oct-19 Dec): The number of phones in Port-au-Prince stayed relatively constant with two short deviations around All Saints day (1 Nov.) and the election day (28 Nov).

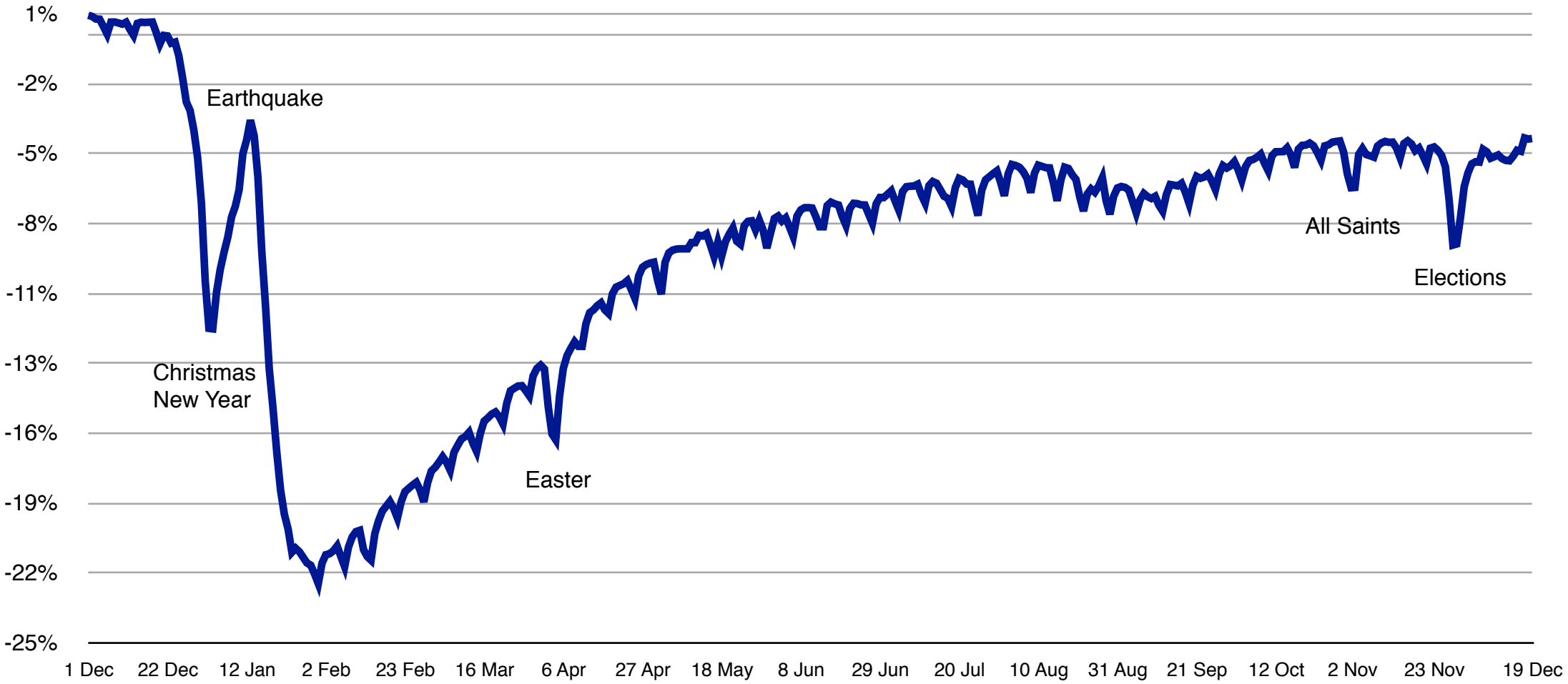

Figure 1: Changes in the number of studied mobile phones inside Port-au-Prince compared to the number present in Port-au-Prince on 21 December, 2009. Observe that the changes are only due to migration, see method section.

2. **Mobile phones in the departments (provinces)**

There was a net in-migration of mobile phones into all other departments after the earthquake. The net increase of phones was at its highest at the end of January. After March there was a strong decline towards pre-earthquake levels in all of these departments.

In this section we move away from Port-au-Prince and look at the situation in the 10 departments of Haiti. Figure 2 below shows for each day, the absolute change in the number of mobile phones in each department, compared to the number of phones present in each department on 21 December, 2009. As an example of how to read the figure, there were 41,543 more mobile phones in Sud department on 31 January compared with the number of phones in this department on 21 December, 2009 (due to migration).

The graph shows that the departments that received the largest numbers of mobile phones were Sud and Artibonite. A strong decline towards pre-earthquake levels is then evident in most departments. The departments with the largest net changes, Sud and Artibonite, show the largest declines in absolute terms. From mid July the levels for all departments stabilized but remained clearly above the 2009 pre-christmas level. In the last part of the analysis period, Ouest experienced a small net increase of phones from mid-October through November.

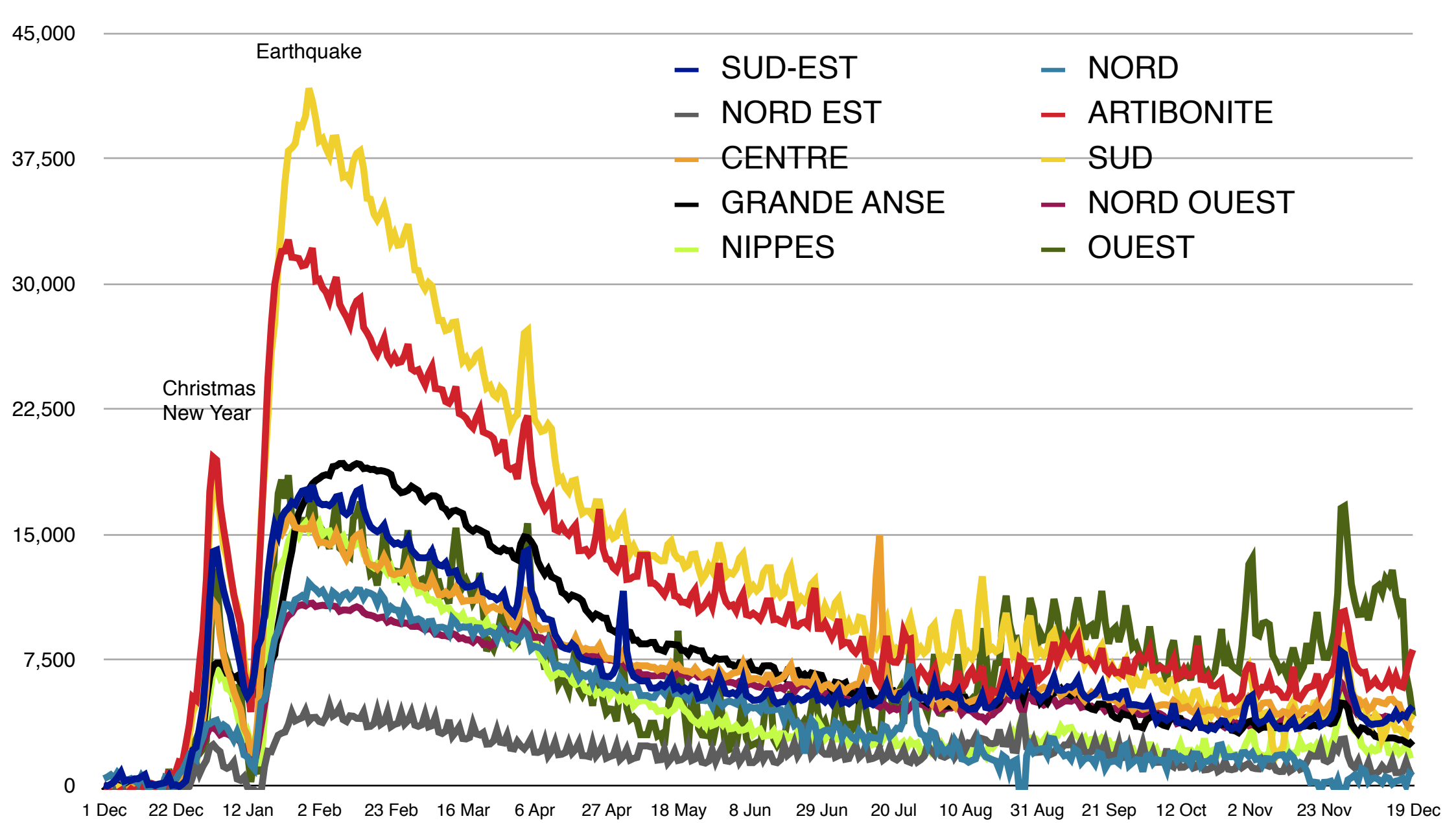

Figure 2: Absolute change in the number of mobile phones in each of the ten departments compared with the number present on 21 December.

3. Movement of sub-groups of mobile phones

Section 1 and 2 have described net changes in the number of phones in Port-au-Prince and in the departments. Net movement between Port-au-Prince and the departments (provinces) is composed of in-flows into Port-au-Prince and out-flows out of Port-au-Prince. In this section we describe some of these more complex movements.

24% of the mobile phones present in Port-au-Prince on the earthquake day had moved out by 31 January. On 19 July the figure was down to 14%. During the autumn the proportion slowly increased to 16% on 19 December.

Figure 3 below shows the proportion of all mobile phones in Port-au-Prince the day before the earthquake that were located outside Port-au-Prince on consecutive dates after the earthquake.[4] Following the large outflow of phones from Port-au-Prince after the earthquake the proportion reached 24% on 31 January. People that had moved out from Port-au-Prince then gradually returned back and the proportion outside Port-au-Prince decreased to around 13%. From the end of July this proportion started to slowly grow again.

Note that at the time of the earthquake there were people in Port-au-Prince on temporary visits. This means that if all people who left Port-au-Prince after the earthquake would return to their homes, the proportion located outside Port-au-Prince (figure 3) should not be expected to reach zero. Also note that the longer time period we are considering, the more people who were in Port-au-Prince on the earthquake day would move to another part of the country for non-earthquake related reasons (e.g. studies, work, visits etc).

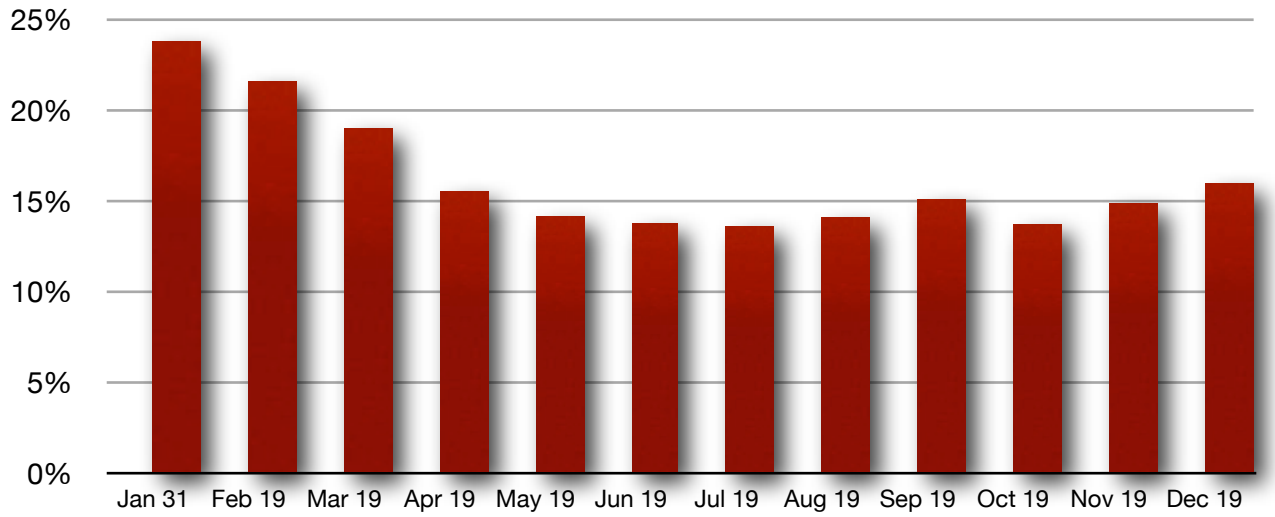

Figure 3: The proportion of the mobile phones present in Port-au-Prince on the earthquake day that were located outside Port-au-Prince at consecutive dates. 31 January was the day with the highest proportion outside Port-au-Prince.

[4] "Present in Port-au-Prince at the day before the earthquake" is defined as having made the most recent phone call before the earthquake from within Port-au-Prince

68% of mobile phones that had left Port-au-Prince on 31 January had returned by 19 December.

Figure 3 above shows that large numbers of mobile phones left the city after the earthquake. On 31 January the number of mobile phones in Port-au-Prince was at its lowest point (see figure 1). We now look at the rate of return of those mobile phones that had left the city by 31 January.

Figure 4 below shows the proportion of the mobile phones that had returned to Port-au-Prince at consecutive dates (out of the phones that were present in Port-au-Prince on the day of the earthquake and that had left the city by 31 January). There was a gradual return of phones to Port-au-Prince during the spring after which the proportion stabilized at 68% during the autumn. Again, note that we should not expect a 100% return rate to Port-au-Prince even if all these persons had returned to their proper home (see above).

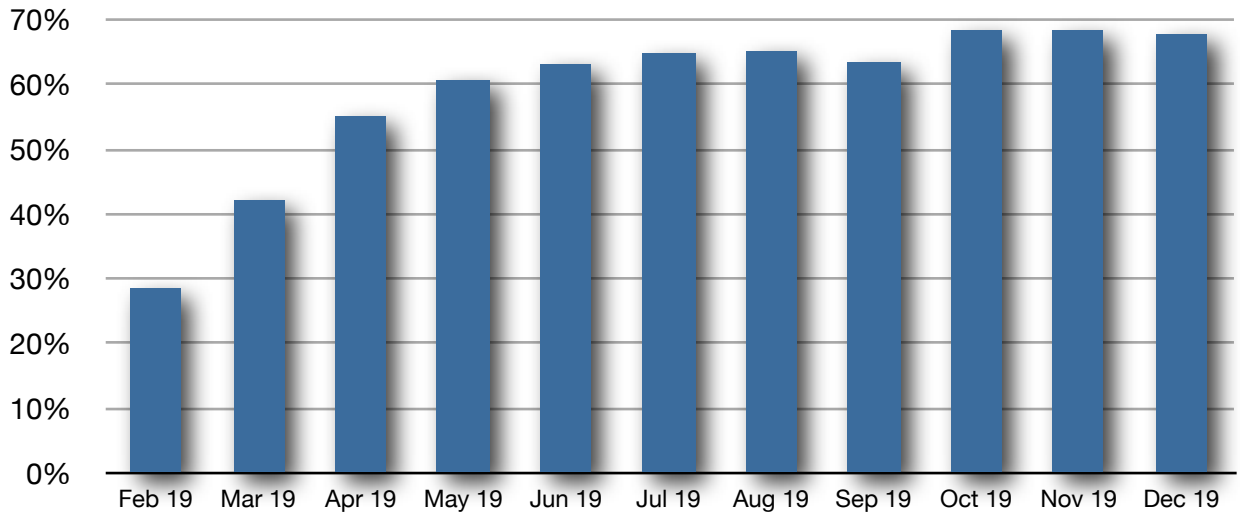

Figure 4: Return rate into Port-au-Prince of mobile phones that were present in Port-au-Prince the day before the earthquake and had left by 31 January. At the end of the year approximately 68% had returned to Port-au-Prince.

The mobile phone data suggests that on 19 December an estimated excess 110,000 to 190,000 persons were staying in the 10 departments.

There were 4.4% fewer phones (34,763 phones) in Port-au-Prince on 19 December 2010 than a year earlier. This fact in combination with the data in figure 3 and figure 4 suggests that many former Port-au-Prince residents still stay outside the capital.

Given the current lack of knowledge on how well mobile phone movements represent movements of non-mobile phone users we have to be cautious when estimating the number of persons that this change in the number of phones represents.

There was one phone per 3.3 persons in Port-au-Prince and 5.4 per person outside Port-au-Prince before the earthquake.[5] Using these figures suggests that 110,000 to 190,000 more persons are located outside the capital at 19 December 2010 compared to 21 December 2009.

[5] Refers to the phones included in the study sample, see methods.

For migration specialists: There is no clear evidence pointing towards higher than normal numbers of non-Port-au-Prince inhabitants moving into Port-au-Prince but the issue is difficult to assess because normal movement patterns are not known.

As the majority of relief resources have been focused on the Port-au-Prince metropolitan area, we looked for indications that Port-au-Prince may have attracted large numbers of new people from outside the city. For specialist in the area, we here show a graph of the migration-induced changes of mobile phones within Port-au-Prince. The top line shows the total number of studied mobile phones (see methods) within Port-au-Prince (magnification of this figure forms figure 1). The second line from the top show the number of phones inside Port-au-Prince that were present in Port-au-Prince on the day of the earthquake. This line gradually slopes downward during the later part of the period because of outflow from the city. The third line from the top shows the number of phones inside PaP that were outside PaP on the day of the earthquake. This shows a gradual and stable increase. The bottom line shows the phones that did not have any registration within Port-au-Prince before the earthquake (1 December to 12 January). This line is thus a subgroup of the phones shown in the red line.

To summarize the figure, a continuous in-migration and out-migration is taking place. These compensate for each other. It is however possible that a smaller proportion of persons that move into Port-au-Prince use mobile phones compared to the people moving out.

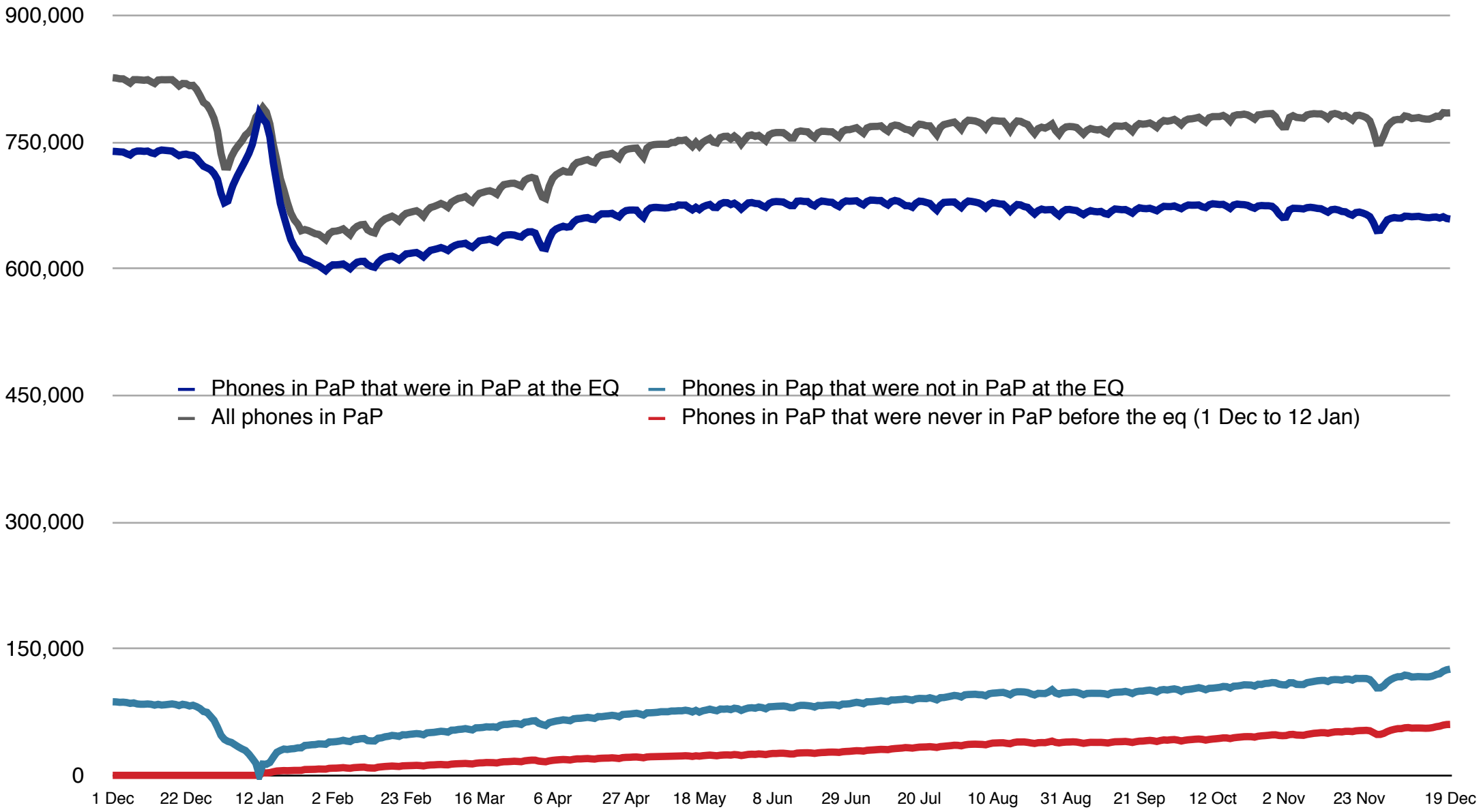

Figure 5: Number of phones in PaP divided into sub-groups depending on location before and at the earthquake.

E. Conclusions

The method we have used tracks population displacement after a disaster. Further studies and in-depth analysis are however required and we hope to return with such data.

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G. Additional acknowledgements

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H. Annex

Definition of the Port-au-Prince metropolitan area

The following communal sections are included in the Port-au-Prince metropolitan area.

Communal Sections	
9ème Bizoton	7ème Bellevue Chardonnire
13ème Corail Thor	1ère Montagne Noire
16ème Tafer	3ème Etang du Jong
10ème Thor	4ème Bellevue la Montagne
2ème Varreux	1ère Varreux
14ème Morne Chandelle	2ème Varreux
15ème Platon Dufrn	8ème Martissant
11ème Rivère Froide	7ème Morne l'Hopital
1ère Petit Bois	6ème Turgeau
3ème Bellevue	1ère Saint martin
4ème Bellevue	2ème Varreux