Population movements following the Haiti earthquake on 14 August 2021 and the Tropical Depression Grace, estimated with mobile operator data from Digicel Haiti: report from 27 August.

Update: Data taken into account until Monday 23 August included.

Summary

The earthquake of Saturday 14 August 2021 and the passage of the Tropical Depression Grace in Haiti have led to population displacement and caused severe destruction (130,000 homes damaged or destroyed as per 22 August OCHA situation report[1]). Based on our analyses of mobile operator data (Call Detail Records, CDR) up to 23 August, an estimated 90,000 people in the South, Nippes and Grand'Anse departments have moved from their pre-earthquake usual locations. The proportion of the population having moved varies greatly between administrative areas.

The analyses in this report explore movements of Digicel subscribers, comparing their usual location during the week preceding the earthquake with their locations during the period 21-23 August (see Box 1 for more details and the Data considerations section). People move for a number of reasons. The movements in this report include displaced persons, persons moving for reasons related to the recent events (but not necessarily to be defined as displaced), and those who would have moved regardless of the recent events. The analyses do not include people who were staying outside the South, Nippes and Grand'Anse departments in the week before the earthquake.

Our estimates show that, out of the people who changed their location after the earthquake, half of them were staying before the earthquake in the communes of Les Cayes, Jeremie, Camp Perrin, Dame Marie, Aquin and Port-Salut (Maps 1 and 2). However, some less populated communes had communal sections with large proportions of their population moving to a new location (within or outside the communal section). For example, more than fifty percent of the population of some of the communal sections of Camp Perrin, Saint Jean du Sud, Petit Trou de Nippes, Maniche, L'Asile and Arnaud are identified as having changed location. Many of these movements took place over short distances. We recommend investigating conditions in these areas and we cannot at this stage fully exclude that biases due to network issues, or other data-related causes, play a role in these results.

On 23 August, the largest number of people to have moved (15,000 persons) is estimated to be in Bourdet, a communal section of Les Cayes. The numbers of relocated people who arrived in the communal sections of Champlois (commune of Camp Perrin) and Grandoit (commune of Anse d'Hainault) are estimated to be nearly 10,000 and 4,500 persons respectively. Nearly half of the relocated people (45,000 persons) are widely spread across 62 communal sections and 26 communes out of 43, in estimated numbers ranging from 100 to 2,000 persons per communal section (Maps 3 and 4).

As the estimated movements are mostly happening over short distances and therefore mostly within communes boundaries, there are no major changes in population numbers at communal level (Map 5). An increase of more than 30% relative to the week before the earthquake is however observed in some communal sections of L'Asile, Cavaillon, Miragoane and Petite Rivière de Nippes (Map 6). The largest relative decrease is observed in the Barriadelle section in the commune of Dame Marie (-67%). We recommend further investigation into the conditions in these areas, while we cannot at this point exclude that biases are responsible.

Movements between Les Cayes and Jérémie were interrupted on Sunday 15 August and resumed on Wednesday 18 August.

Additional results and maps at commune and communal section levels are presented below. These results will be updated on a regular basis. They are still to be considered as preliminary and come with caveats (see Data considerations section). The analyses can be adapted according to the information needs of the operational actors. Queries and requests for discussions can be sent to info@flowminder.org.

Box 1 | Definition of location & movement

Cell towers in close proximity are grouped together in clusters to limit biases, including those associated with call forwarding between nearby towers. The seven days preceding the earthquake is taken as a baseline. For each subscriber, the baseline usual location is defined as the cell cluster from which most of the last calls of each day are made. The same is done for the period 21-23 August. A movement is defined as a change of cell cluster defined as usual location between baseline and 21-23 August.

[1] OCHA, Haiti: Earthquake Situation Report No. 1 (22 August 2021), accessed on 27.08.2021 at https://www.humanitarianresponse.info/en/operations/haiti/document/haiti-earthquake-situation-report-no-1-22-august-2021.

Departures per administrative area

In the three departments of Grand'Anse, Sud and Nippes, we estimate that approximately 90,000 people have moved from their pre-earthquake location. Most of these persons have moved short distances.

Affected areas with more than 50% of people having moved lie within the communes of Camp Perrin (Sections Tibi Davesac and Champlois), Dame Marie (section Bariadelle), Maniche (section Melon), Saint Jean du Sud (section Tapion), Petit Trou de Nippes (sections Raymond and Lieve), L'Asile (section L'Asile) and Arnaud (sections Arnaud and Baconnois-Barreau).

Half of the people having moved were staying before the earthquake in the communes of Les Cayes (section Bourdet, 32% have moved), Jeremie (sections Fond Rouge Dahere 28% have moved, Fond rouge Torbeck 25% have moved), Camp Perrin (sections Champlois 80% and Levy Marsan 37%), Dame Marie (section Bariadelle 96%), Aquin (sections Frangipane 49% and Brodequin 15%) and Port-Salut (section Barbois 32%).[2]

Arrivals per administrative area

The single largest number of people who moved (15,000 persons) can be found in section Bourdet of Les Cayes. The number of relocated people in section Champlois of Camp Perrin and section Grandoit of Anse d'Hainault are estimated to be nearly 10,000 and 4,500 respectively.

More than 2,000 relocated people can be found in each of the following communal sections: Fond Rouge Dahere (commune of Jeremie), Levy Mersan (Camp Perrin), Brodequin (Aquin) and Anote (or Tapion, Moron).

Nearly half of the relocated people (45,000 people) are widely spread across 62 communal sections and 26 communes out of 43, in estimated numbers ranging from 100 to 2,000 per communal section.

Change in population numbers per administrative area

As relocation is mostly happening on short distances, changes in population distribution at commune level are hardly visibles on maps.

An increase of more than 30% at communal section level relative to the week before the earthquake is however observed in the communes of L'Asile (section Changeux), Cavaillon (section Laroque), Miragoane (section Dessources) and Petite Riviere de Nippes (section Bezin).

The largest relative decrease is observed in section Barriadelle of Dame Marie (-67%).[3]

In absolute numbers, increases of more than 1,000 people are seen in section Grandoit of Anse d'Hainault, section Anote (or Tapion) of Moron, section Champlois of Camp Perrin, section Fonfrede of Les Cayes and section Dumont of Port-Salut.

Data considerations

The estimates shown are our best current assessment of movements. However there are a number of uncertainties, some of which will be addressed in later analyses. The numbers given should not be interpreted as the truth and should be interpreted with other available evidence, notably derived from field surveys and reports. These uncertainties are caused by several factors. The results were produced on the sample of Digicel Haiti subscribers calling most frequently and regularly in order to limit the biases associated with changes in calling patterns after the earthquake and Tropical depression Grace. However, these preliminary results may nevertheless be affected by the change in subscriber behaviour following these events, and the movements of these sampled subscribers may not be representative of those of the entire population. Due to network saturation or technical damage to cells, results may also be affected by the redirection of calls to towers further away than those directly near to some subscribers. The results are also influenced by the size of the areas covered by the cell towers. In very sparsely populated areas, sufficient data is not available to compute the indicators. Lastly, the method used to assess people's location has significant uncertainties.

Data Protection & Privacy

No personal data, such as an individual's identity, demographics, location, contacts or movements, is made available to the government or any other third party at any time. All results produced by Digicel Haiti and the Flowminder Foundation are aggregated results (for example, subscriber density in a given municipality), which means that they do not contain any information about individual subscribers. This data is fully anonymised. This approach complies with the European Union's General Data Protection Regulation (EU GDPR 2016/679). Data is processed on a server installed behind Digicel Haiti's firewall, and no personal data leaves Digicel Haiti's premises.

Data

For billing purposes, mobile operators keep track of subscribers activity. These records are generated every time a subscriber makes or receives a call, sends or receives an SMS, or uses mobile data on their phone. They are called Call Detail Records (CDRs). CDRs contain information about the location of the cell tower that routes the call. These data can be analysed in near real time and provides insight into mobility patterns locally and across a country.

This report is based on the results of an analysis of CDR data provided by Digicel Haiti. CDRs are de-identified by Digicel Haiti and then analysed by Flowminder.

[2] Large numbers (above 80%) should be further investigated and may be caused by various biases (e.g network issues, analytical biases related to a small number of subscribers in this particular location).

[3] This figure reflects the baseline population minus the departure out of Barriadelle plus the arrival into Barriadelle. This is to be contrasted with movement out of usual location (within and outside Barriades): 96% of the Barriades population at baseline. Both figures are hence not directly comparable and need to be considered with care (footnote 2).

Proportion of people having moved out of their usual location

Definition

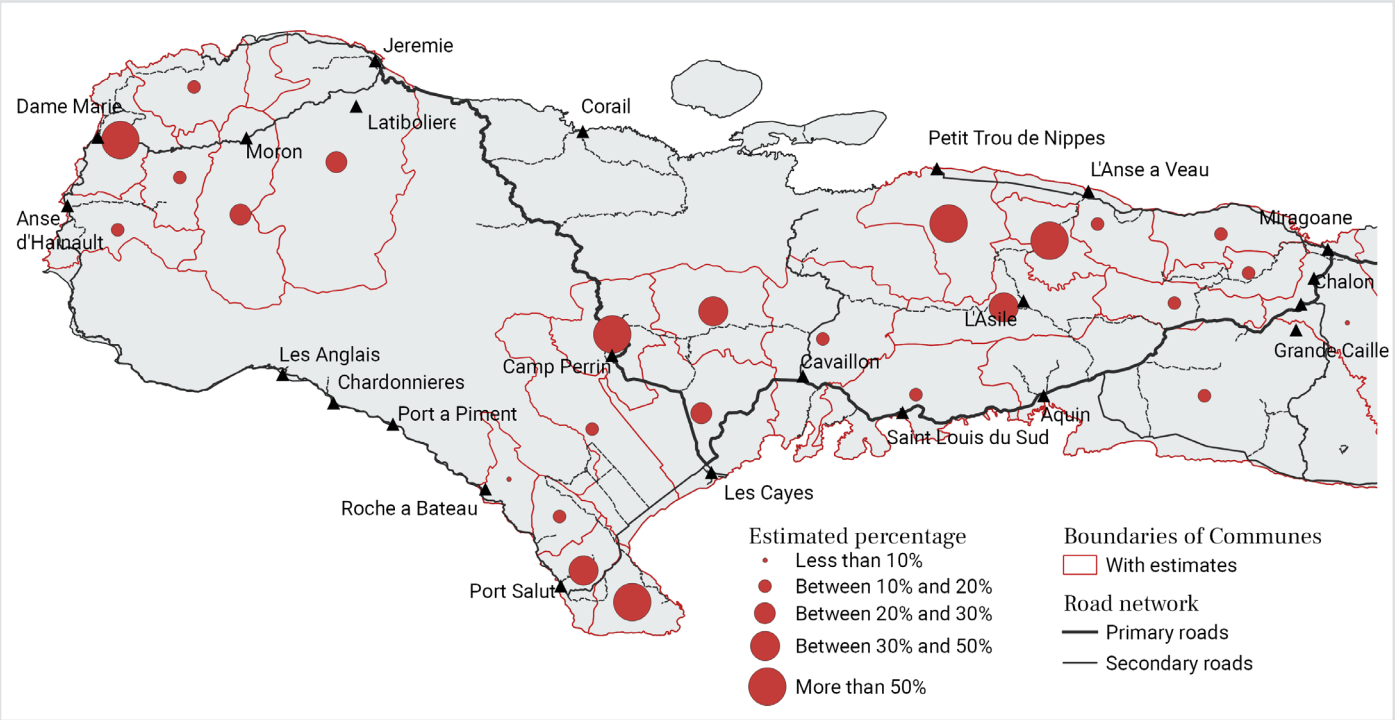
The indicator is the proportion of people per administrative area having moved out of their usual location between the seven days preceding the earthquake (baseline) and the three days leading up to 23 August. The move may be either within or outside the administrative area where people lived before the earthquake (see Box 2 for details).

Reading the maps

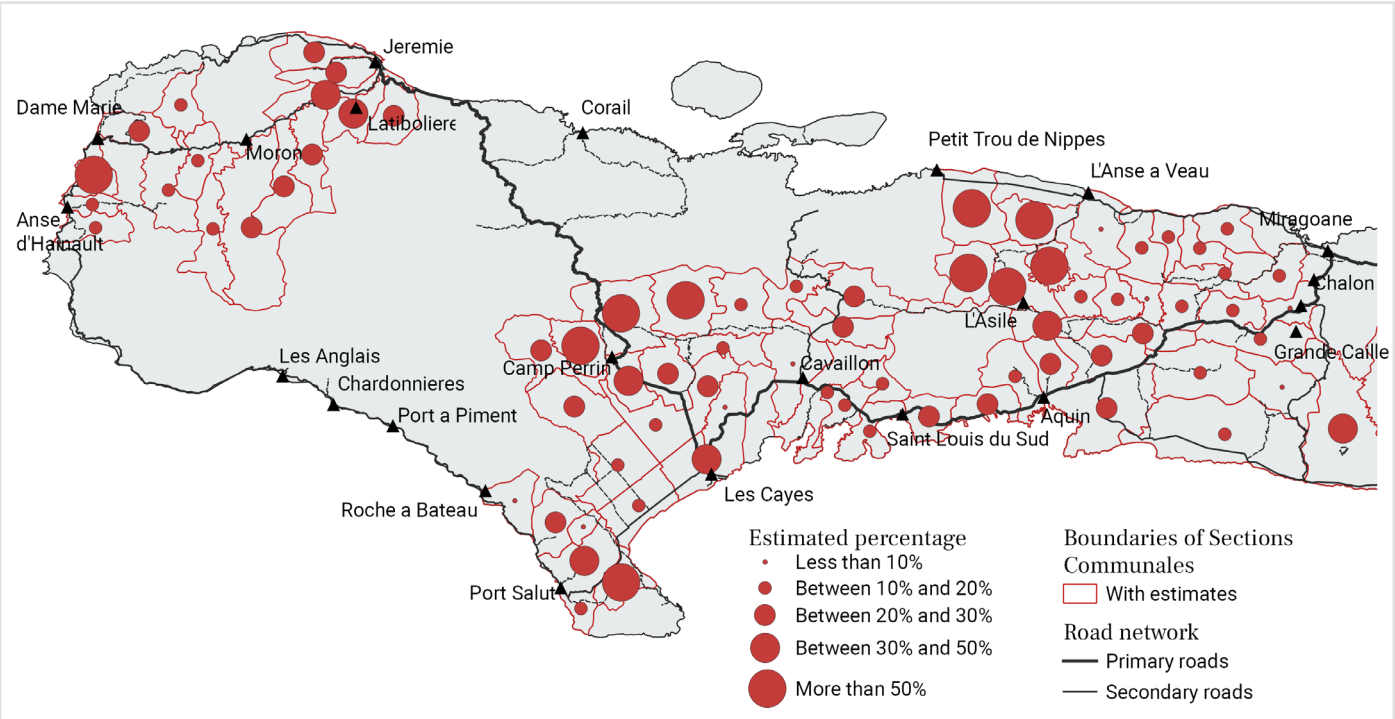
The size of the red dots represent the proportion of people having moved out of their usual location in each administrative area: the larger the dot, the greater proportion of people who moved out of their usual location, either to a new location within the administrative area or outside the administrative area (see legend for the scale).

The boundaries of the administrative areas are in red. Administrative areas with insufficient data are not delineated (see Data considerations).

Results are provided at commune (Map 1) and communal section levels (Map 2).



Map 1 | Proportion of people having moved out of their usual location per commune



Map 2 | Proportion of people having moved out of their usual location per communal section

Box 2 | Calculation of the proportion of people having moved out of their stay location

Calculation of change in location: Cell towers in close proximity are grouped together in clusters to limit biases, including those associated with call forwarding between nearby towers. The seven days preceding the earthquake is taken as a baseline. For each subscriber, the baseline location is defined as the cell cluster from which most of the last calls of each day are made. The same is done for the rolling window of three days starting with the day of the earthquake and leading up to 23 of August, hereafter referred to as the comparison period. In order to approximate number of people having changed location, rather than number of subscribers, a population scaling factor is used: if there are 10 subscribers included in the analysis and located in a given area, and an estimated pre-earthquake population of 50 in this area, the scaling factor is 5 and a change of location of 5 subscribers is assumed to represent a change of location of 25 people.

Indicator: The indicator shown on the map is, for a given section, the sum of people having moved from a baseline location within the section toward a location within or outside the section divided by the sum of people living within the section (i.e. with baseline location within the given section).

Additional remark: The population count at cluster level is obtained by counting the number of people living in the area covered by the signal coverage of the cells of each cell cluster (12/5'000 metres viewshed algorithm from QGIS, areas covered by multiple clusters are allocated to the closest one according to a voronoi polygon). The population data used is the CIESIN 2018 High Resolution Settlement Layer.[4] Only cell tower clusters with 15 or more daily active subscribers are considered.

Number of people having moved into a new location

Definition

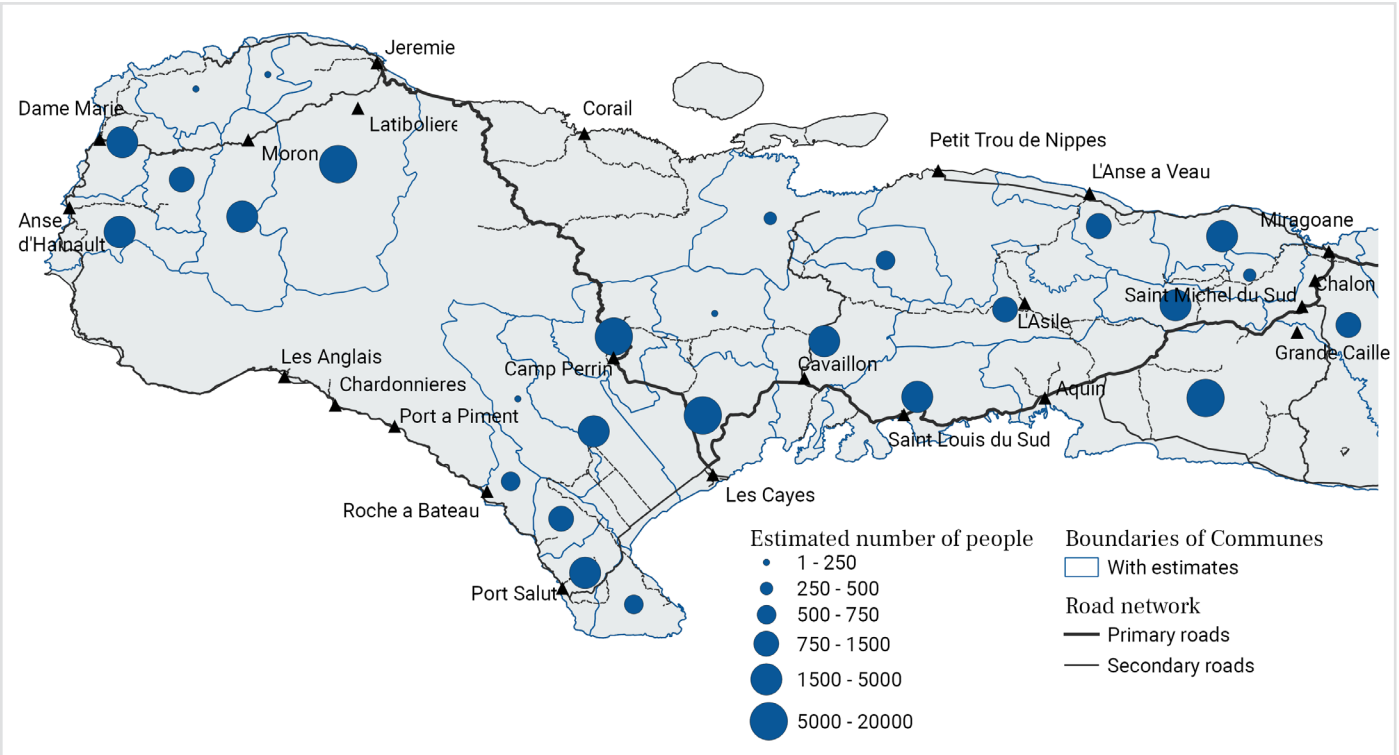
The indicator is the number of people per section having moved into a new location between the seven days preceding the earthquake and the three days leading up to the 23rd of August. The move may be either from within or from outside the administrative area where people lived before the earthquake (see Box 3 for details).

Reading the maps

The size of the blue dots represent the number of people having changed their location in each administrative area: the larger is the dot, the greater is the number of people who moved in, either from within the administrative area or from outside the administrative area (see legend for the scale).

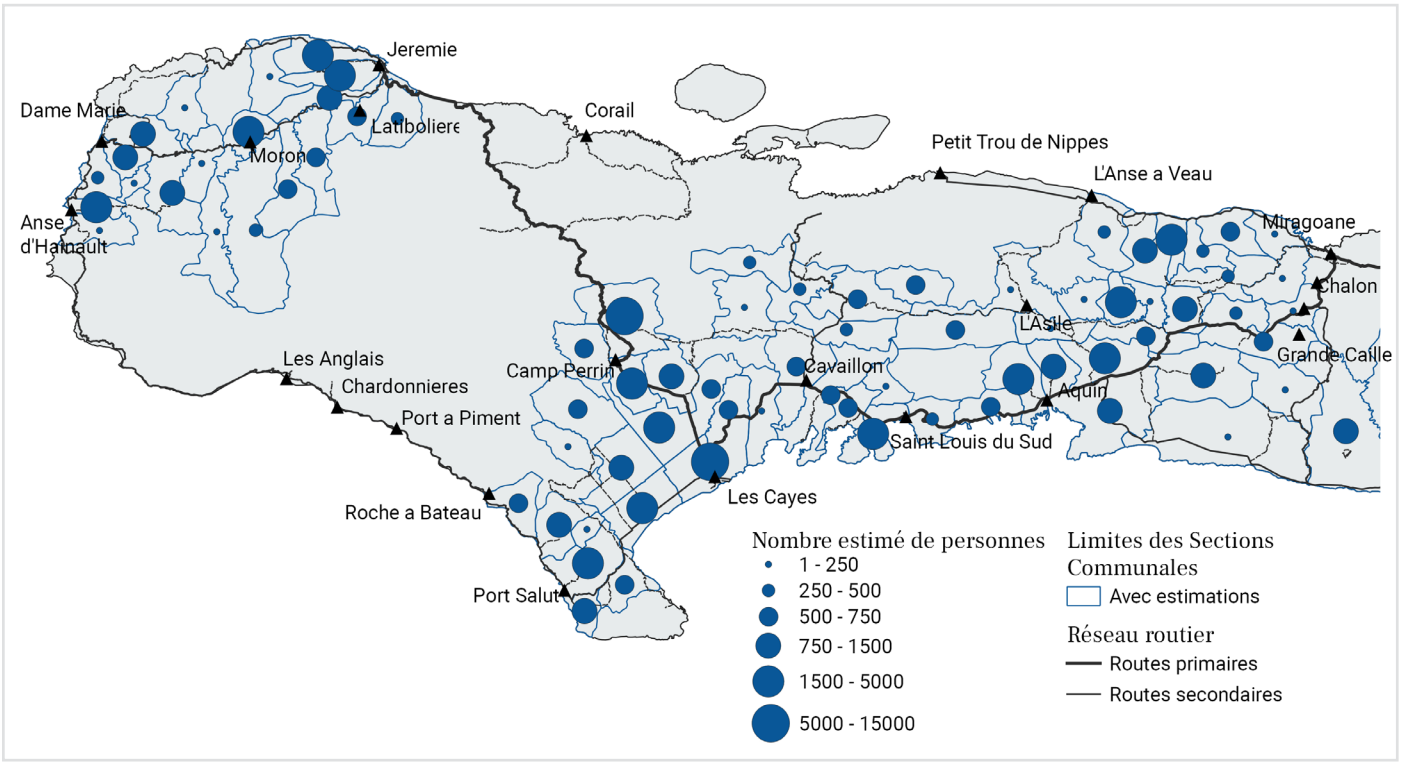
The boundaries of the administrative area are in blue. Administrative areas with insufficient data are not delineated (see Data considerations).

Results are provided at communal (Map 3) and communal section levels (Map 4)



Map 3 | Number of people having moved into a new stay location per commune

[4] Facebook Connectivity Lab and Center for International Earth Science Information Network - CIESIN - Columbia University. 2016. High Resolution Settlement Layer (HRSL). Source imagery for HRSL © 2016 DigitalGlobe. Accessed 25 Aug 2021



Map 4 | Number of people having moved into a new stay location per communal section

Box 3 | Calculation of number of people having moved into a new location

Calculation of change in location: Cell towers in close proximity are grouped together in clusters to limit the bias associated with call forwarding between nearby towers. The seven days preceding the earthquake is taken as a baseline. For each subscriber, the baseline location is defined as the cell cluster from which most of the last calls of each day are made. The same is done for the rolling window of three days starting from the day of the earthquake and leading up to 23 August, hereafter referred to as the comparison period. In order to approximate number of people having changed location, rather than number of subscribers, a population scaling factor is used: if there are 10 subscribers included in the analysis and located in a given area, and an estimated pre-earthquake population of 50 in this area, the scaling factor is 5 and a change of location of 5 subscribers is assumed to represent a change of location of 25 people.

Indicator: The indicator shown on the map is, for a given section, the sum of people having moved from a baseline location within or outside the administrative area towards a location within the administrative area.

Additional remark: The population count at cluster level is obtained by counting the number of people living in the area covered by the signal coverage of the cells of each cell cluster (12/5'000 metres viewshed algorithm from QGIS, areas covered by multiple clusters are allocated to the closest one according to a voronoi polygon). The population data used is the CIESIN 2018 High Resolution Settlement Layer.[5] Only cell tower clusters with 15 or more daily active subscribers are considered.

Change in population count as percentage of pre-earthquake period

Definition

The indicator is the change in population count per administrative area between the seven days preceding the earthquake (baseline period) and the three days leading up to 23 August expressed as a percentage of the population per administrative area in the baseline period (see Box 4 for details).

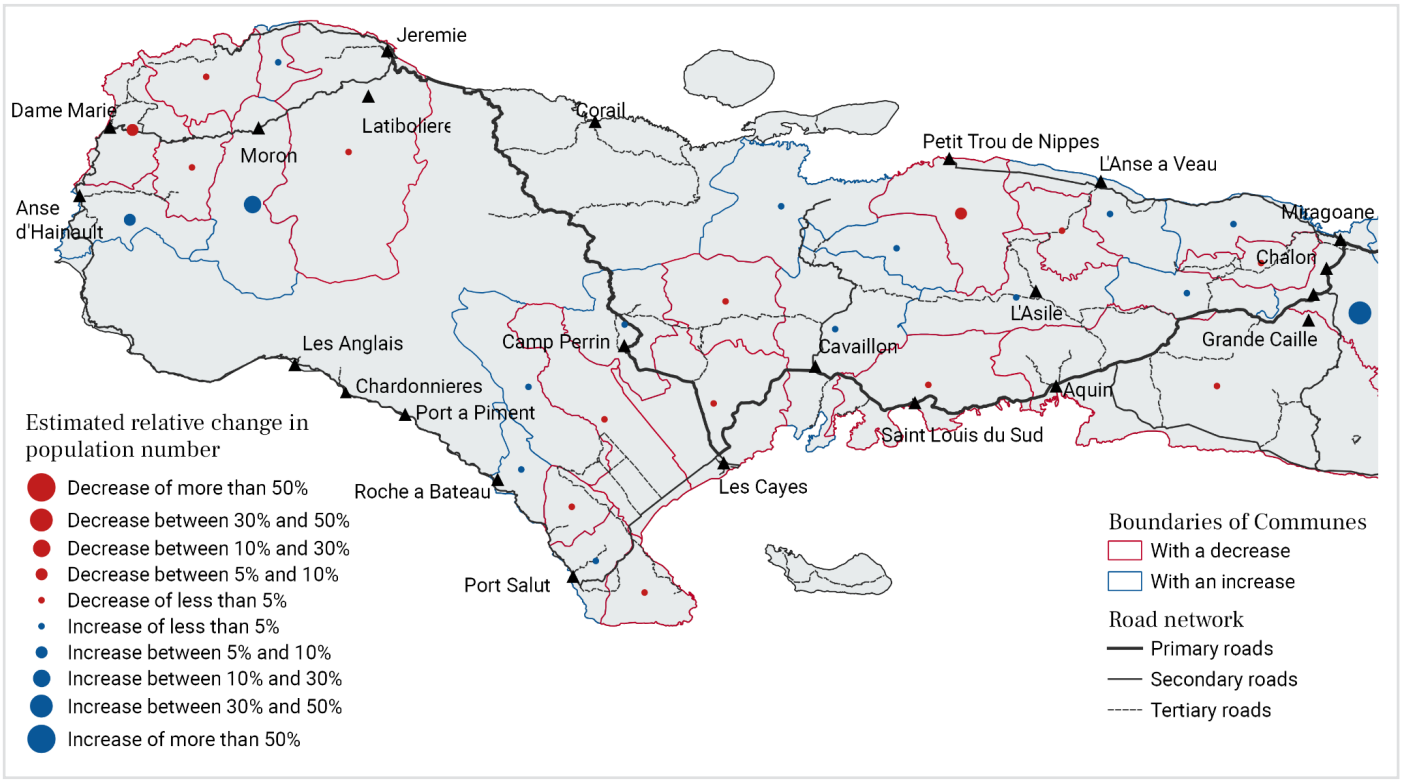
Reading the graph

A blue dot means that the population increased compared to the baseline period. A red dot indicates that the population decreased compared to the baseline period. The larger is the dot, the larger the change is compared to the baseline (see legend).

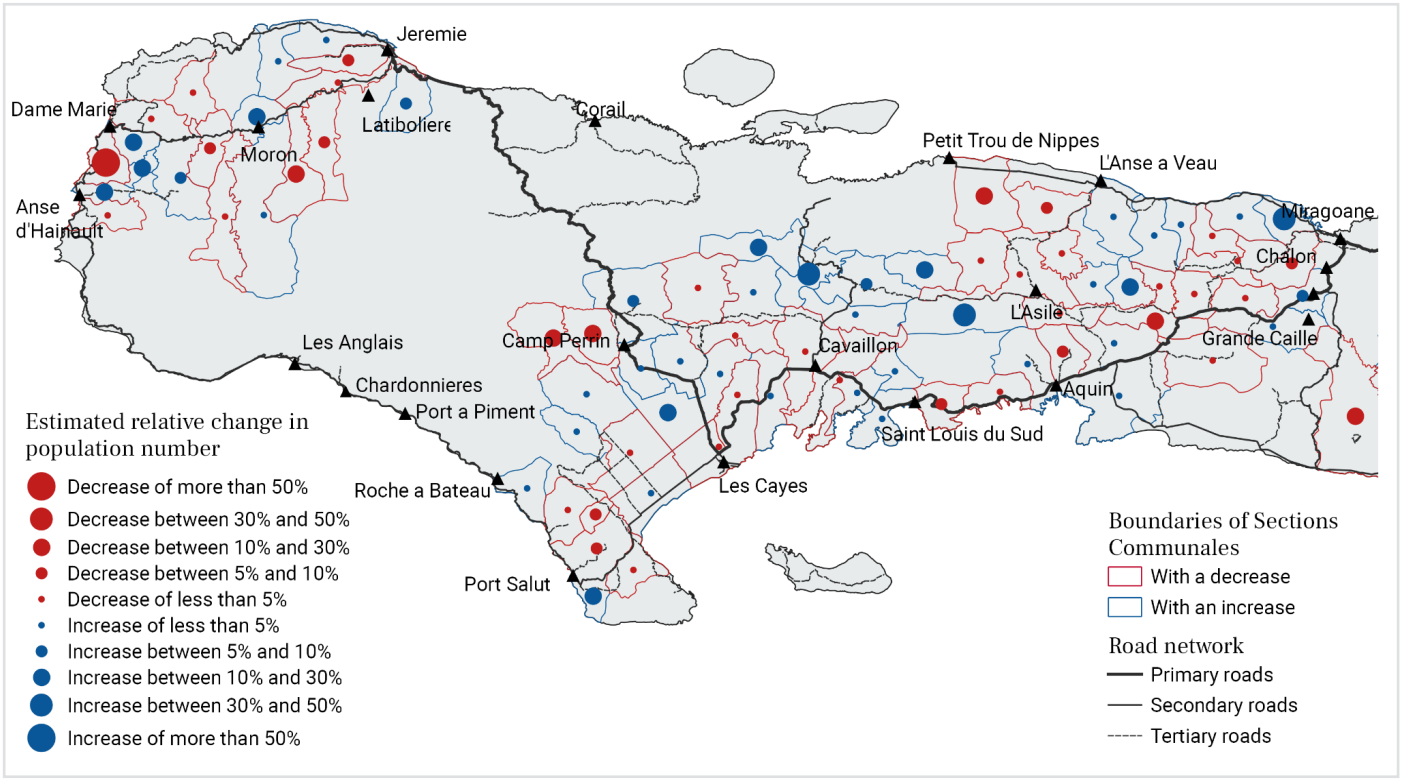
Administrative areas with insufficient data are not delineated (see Data considerations).

Results are provided at communal (Map 5) and communal section levels (Map 6)

[5] Facebook Connectivity Lab and Center for International Earth Science Information Network - CIESIN - Columbia University. 2016. High Resolution Settlement Layer (HRSL). Source imagery for HRSL © 2016 DigitalGlobe. Accessed 25 Aug 2021



Map 5 | Change in population count as percentage of pre-earthquake period per commune



Map 6 | Change in population count as percentage of pre-earthquake period per communal section

Box 4 | Calculation of the change in population count as percentage of pre-earthquake period

Calculation of change in population count: Cell towers in close proximity are grouped together in clusters to limit the bias associated with call forwarding between nearby towers. The seven days preceding the earthquake is taken as a baseline. For each subscriber, the baseline location is defined as the cell cluster from which most of the last calls of each day are made. The same is done for the rolling window of three days starting from the day of the earthquake and leading up to 23 August, hereafter referred to as the comparison period. In order to approximate number of people having changed location, rather than number of subscribers, a population scaling factor is used: if there are 10 subscribers included in the analysis and located in a given area, and an estimated pre-earthquake population of 50 in this area, the scaling factor is 5 and a change of location of 5 subscribers is assumed to represent a change of location of 25 people.

Box 4 | Calculation of the change in population count as percentage of pre-earthquake period (cont'd)

Indicator: The indicator shown on the map is, for a given administrative area, the sum of people with location in the comparison period in this administrative area divided by the sum of people with location in the administrative area during the baseline period.

Additional remark: The population count at cluster level is obtained by counting the number of people living in the area covered by the signal coverage of the cells of each cell cluster (12/5'000 metres viewshed algorithm from QGIS, areas covered by multiple clusters are allocated to the closest one according to a voronoi polygon). The population data used is the CIESIN 2018 High Resolution Settlement Layer.[6] Only cell tower clusters with 15 or more daily active subscribers are considered.

Contact us

flowminder.org

@Flowminder

info@flowminder.org

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[6] Facebook Connectivity Lab and Center for International Earth Science Information Network - CIESIN - Columbia University. 2016. High Resolution Settlement Layer (HRSL). Source imagery for HRSL © 2016 DigitalGlobe. Accessed 25 Aug 2021