Haiti: Hurricane Matthew

Estimated Population Movements as of 8 November 2016

Flowminder Foundation - Digicel Haiti - World Food Programme

Produced on 10 November 2016

FLOWMINDER.ORG

Our mission is to improve public health and welfare

We provide global public goods, working with partners to collect, aggregate, integrate and analyze anonymous mobile operator data, satellite and household survey data. We characterize and map vulnerable populations at risk in low- and middle-income countries.

All estimates and maps are available on the WorldPop Project website:
www.worldpop.org

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Background

Call detail records (CDRs) are registered by mobile operators for billing purposes. They include information on the cell tower used by subscribers when sending and receiving text messages and making calls. In de-identified formats, they can be used to estimate mobility patterns of a population. The CDR analysis described here was undertaken in compliance with the GSMA privacy guidelines developed in the context of the Ebola outbreak (GSMA, 2014).

Methodology

Population flow estimation

Haiti has an estimated population of 11 million people. Digicel is the largest operator, having approximately 4.7 million subscribers (85% market share).

We estimate population flows based on movements of de-identified Digicel subscribers who lived pre-hurricane in the affected Departments of Sud, Grande Anse and Nippes. We show estimated flows of people within and out of the affected departments. We show results for Communes and Communal Sections. Population movement estimates are calculated by combining de-identified data on SIM card movements with available population data.

We assume in these analyses that movements of mobile phone subscribers are representative of movements of the population in the three Departments. Mobile phone use is relatively lower in several groups including women, children, the elderly, and the poorest. If these groups have substantially different movement patterns than groups with high mobile phone use, results will be biased. In general the relative distributions of flows across the country are more reliable than absolute numbers given per area. Our previous research in Haiti (post-earthquake) and Kenya (stable conditions) show that overall estimates of mobility corresponded well to population-level data (Bengtsson et al., 2011; Wesolowski et al., 2013). However the estimates provided here should be interpreted with the above mentioned caveats in mind.

Specifically, we show estimated absolute and relative flows as well as flows above and below normal levels.

Absolute flows

Absolute flows are simply the estimated number of people who moved from one location to another. We define the home of each anonymous user before the hurricane (1 June 2016 to 20 September 2016) as the area from which the last call of the day was placed most frequently by the user. We define in the same way the present location of each user based on the period 2 November 2016 to 8 November 2016.

Relative flows

Using the definitions above, relative flows are defined as the estimated number of people who moved from one area to another divided by the total population of the area (IHSI, 2015). For relative flows into an area we divide the estimated number of people who arrived in the area by the population of that area. For relative flows out of an area we divide the estimated number of people who left the area by the population of that area.

Flows above normal

To put the observed population flows into perspective we provide a measure of the magnitude of flows by comparing the post-hurricane flows with pre-hurricane flows. We call these "flows above normal". The estimates are rough and should only be used as an approximate measure.

Importantly, note that most people who have moved after the hurricane are likely to have done so due to the hurricane. The excess number of people who moved, compared to normal, should therefore not be interpreted as an estimate of the number of displaced people. Absolute numbers moving is likely to be a better measure of displacement than above normal movements in this context.

Specifically, we determine the locations of anonymous users during three separate time periods. The first two periods (2016-06-01 to 2016-09-20 and 2016-09-21 to 2016-09-28) do not include any unusual events. The flow between these two periods is defined as the "normal flow". The third period is the location of the user during the most recent period, which allows for calculation of the flow between the first and the third period. The "above normal flow" is defined as the second flow subtracted from the first (Fig. 1). Flows are scaled by census data population estimates (IHSI, 2015).
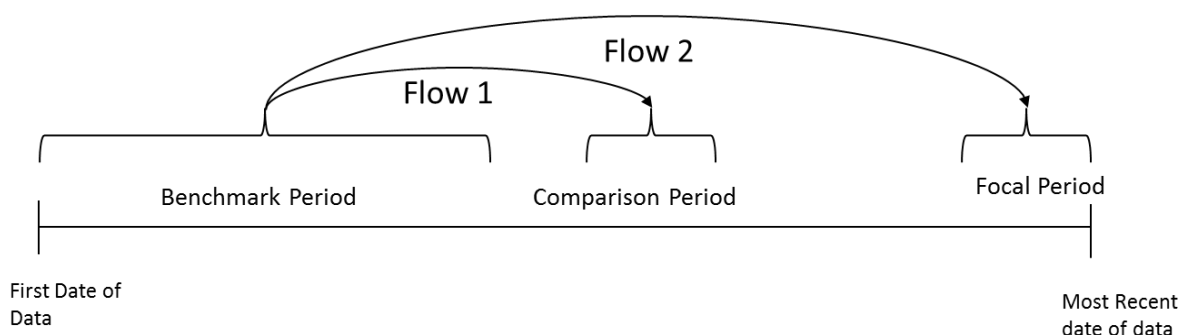

Figure 1. Definition of the time period and flows required to calculate flows above normal. (Benchmark Period: 2016-06-01 - 2016-09-20; Comparison Period: 2016-09-21 - 2016-09-28; Focal Period 2016-11-02 to 2016-11-08)

Supporting Datasets

Haiti Administrative Boundaries Level 0 - 3
UN OCHA Haiti, 5 October 2016
https://data.humdata.org/dataset/hti-polbndl-adm1-cnigs-zip

Haiti - Estimated population of 2015 (with p-codes)
UN OCHA Haiti, 13 October 2016
https://data.humdata.org/dataset/estimated-population-of-haiti-2015

Project Partners

Flowminder Foundation and WorldPop Project
www.flowminder.org www.worldpop.org

The Flowminder team pioneered the analysis of mobile network data to support responses to natural disasters and epidemics (Zanzibar 2009 malaria, Haiti 2010 earthquake and cholera outbreak). The WorldPop project is the leading open data repository for population densities and distributions, and is Flowminder's main dissemination platform.

Digicel www.digicelhaiti.com
Digicel Group is a leading global communications provider with operations in 33 markets in the Caribbean, Central America and Asia Pacific. Digicel is the largest operator in Haiti.

UN World Food Program www.wfp.org
WFP is the world's largest humanitarian agency, fighting hunger worldwide.

Contacts

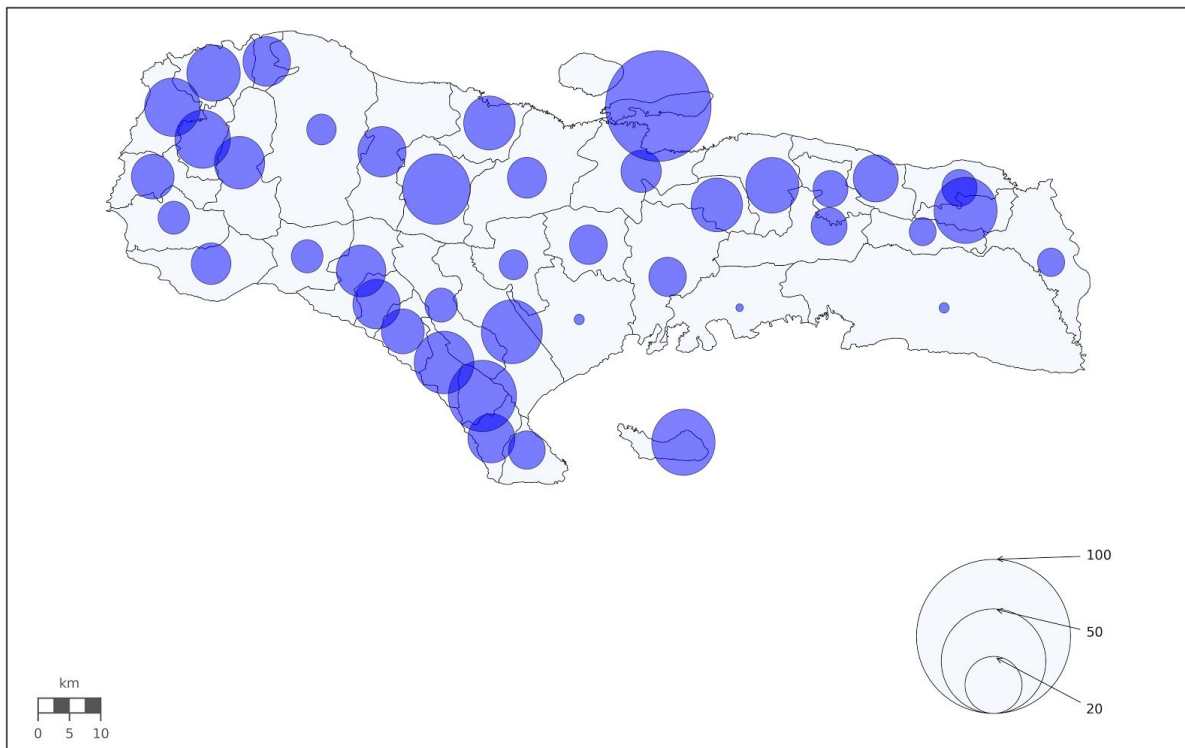Chris Brooks chris.brooks@flowminder.org +44 7815 944012
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Results

Population Outflows

Flows relative to the population

Map 1: Proportion of people who left their Commune. The number of people who left a Commune has been divided by the official 2015 population estimates for that Commune.

The analyses indicate that large proportions of the population have moved away from their home areas. The majority of Communes experienced more than a 15% loss of their populations, with the Communes of Grand Boucan, Arniquet and Beaumont experiencing the most people leaving. However, the **Southeast coast of the Department of Sud saw a small proportion of people leaving.**
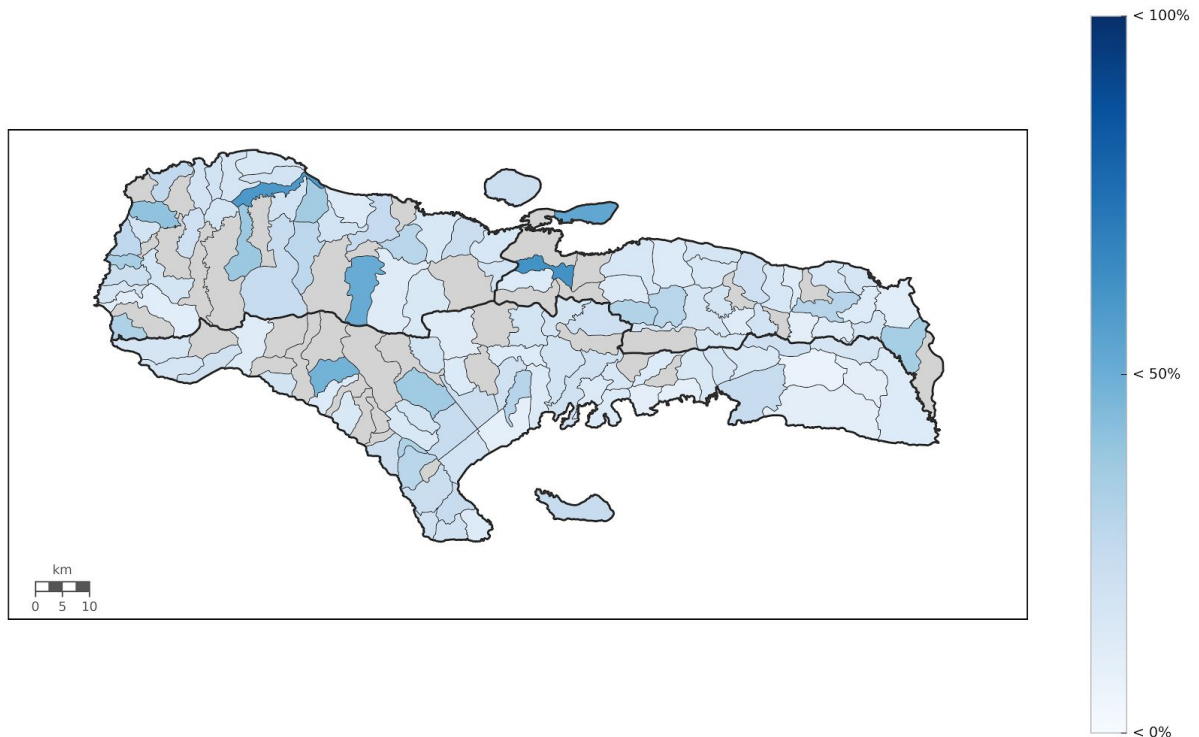
Map 2: Proportion of people who left their Section Communale. The number of people who left a Section Communale has been divided by the official 2015 population estimates for that Section Communale. Grey areas indicate insufficient data.
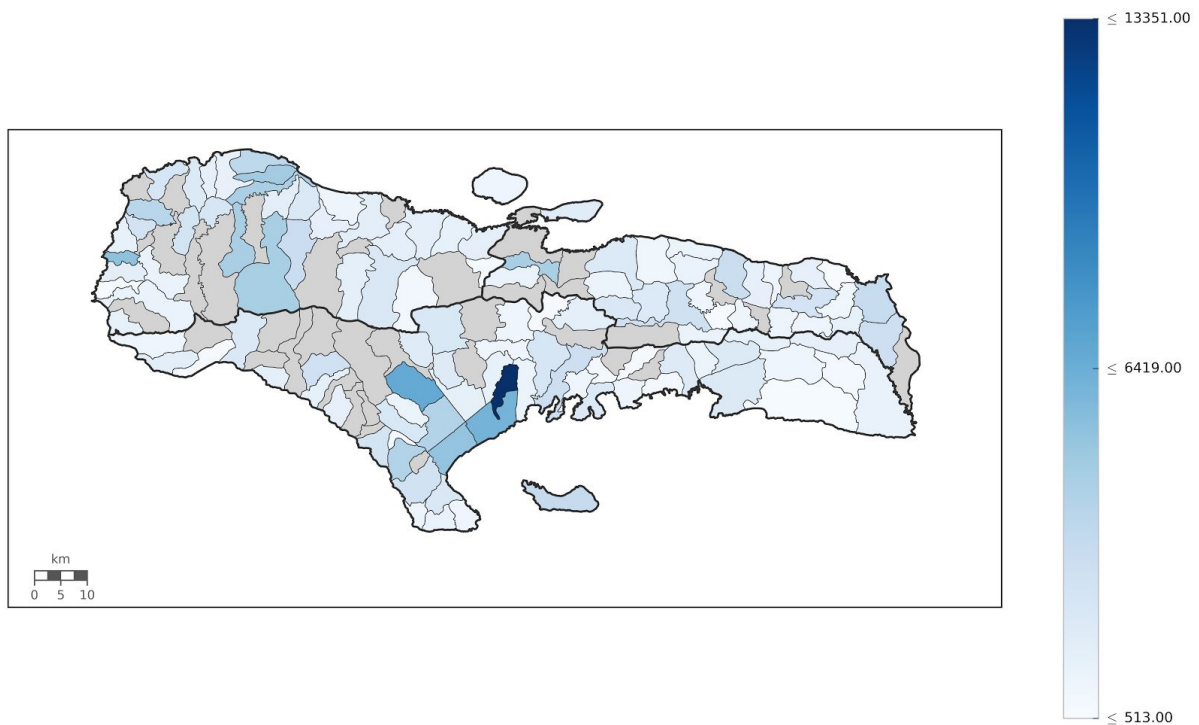
The majority of Section Communales experienced more than an 11% loss of their populations. The Section Communales of La Plaine, Marfranc ou Grande Rivière and Grand-Boucan saw most people leaving.

Absolute flows
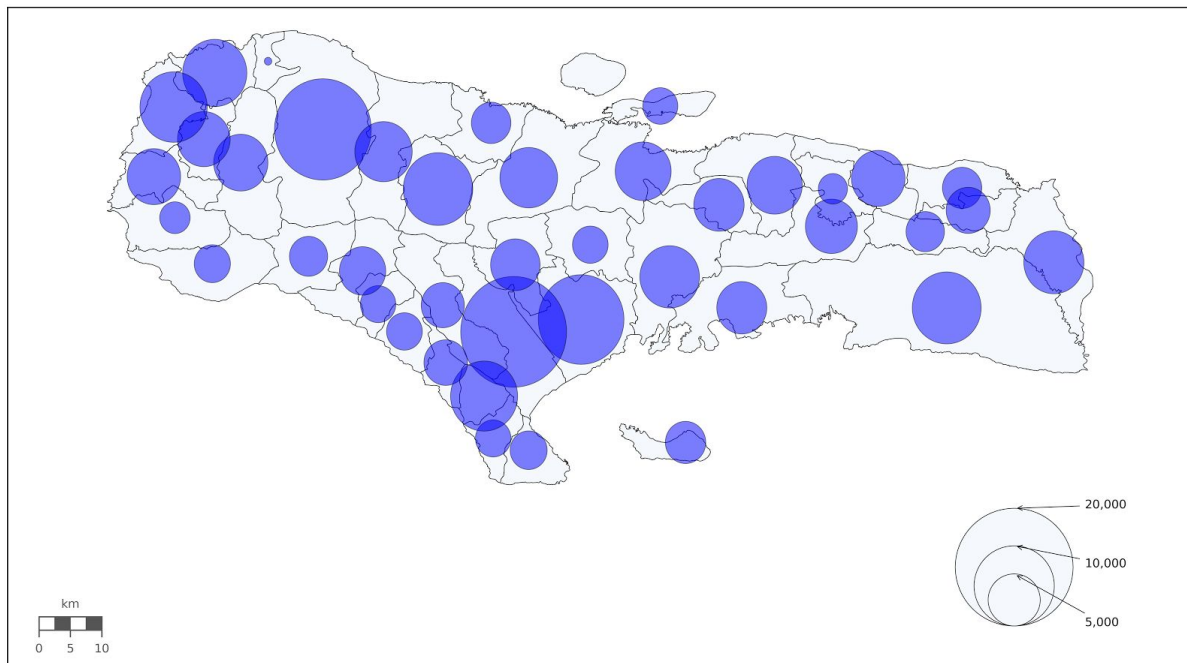
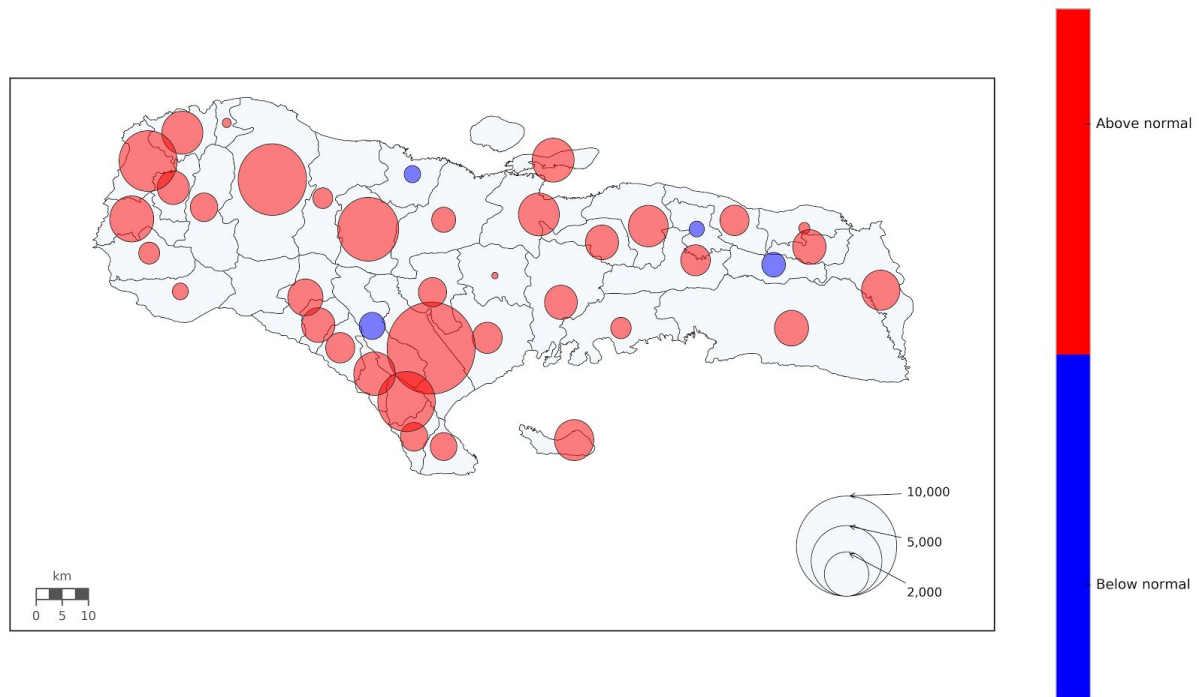*Map 3: Estimated number of people who left their Communes within the Departments of Sud, Grande Anse and Nippes.*

Most Communes saw between 2300 to 8500 people (mean ∓1 std) leaving their homes. The Communes of Torbeck, Jeremie and Les Cayes saw most people leaving in absolute terms. The South West coast of the Department of Sud saw lower numbers of people leaving.

Map 4: Estimated number of people who left their Section Communales within the Departments of Sud, Grande Anse and Nippes.

Most Section Communales experienced a drop in their population of between 500 and 3900 people (mean ∓1 std) . The Section Communales of Laurent, Solon and Bourdet saw most people leaving in absolute terms.

Flows above normal

Map 5: Estimated number of people compared to normal, who left their Communes within the Departments of Sud, Grande Anse and Nippes.

The strong variation in flows above normal across the region indicates disruption to the normal patterns of population movement. Communes experiencing abnormally large outflows of people include Torbeck, Jeremie, Beaumont and Dame-Marie. Flows above normal should not be interpreted as a measure of displacement (see methods).
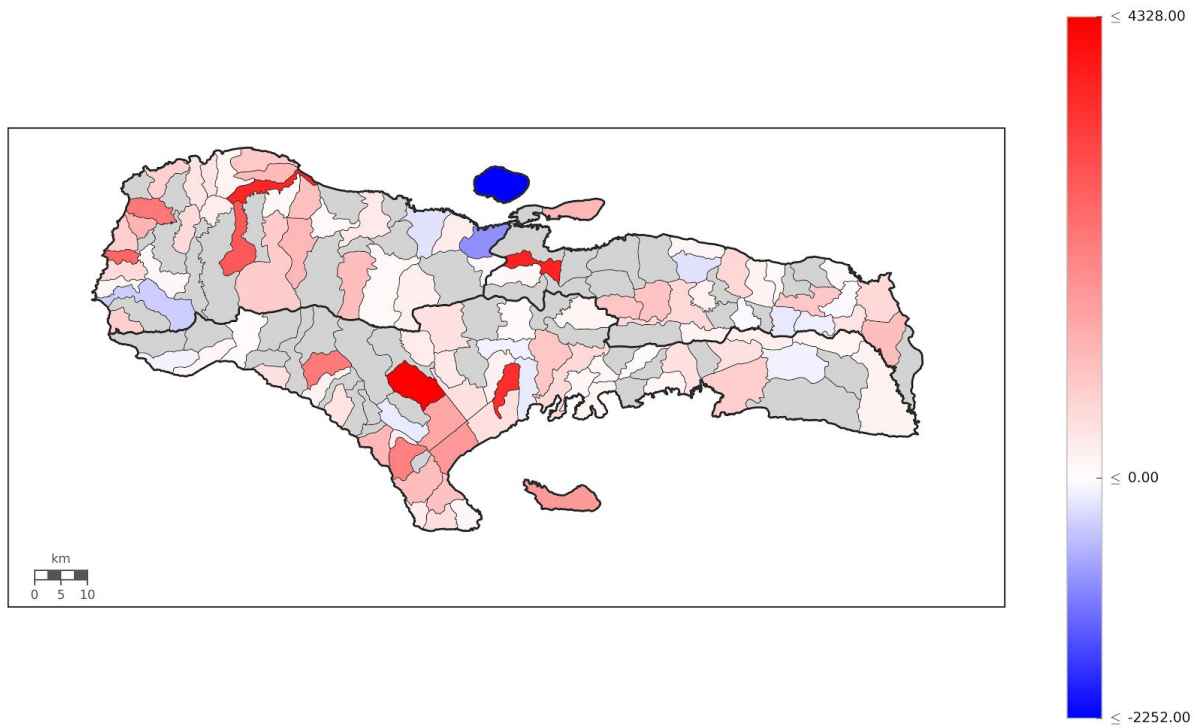
Map 6: Estimated number of people compared to normal, who left their Section Communales in the Departments of Sud, Grande Anse and Nippes.

Similar to the Commune level, a large variation in flows above normal is seen at the Section Communale level. Section Communales experiencing abnormally large increases in outflows of people include Solon, La Plaine, Marfranc ou Grande Rivière and Laurent. Those experiencing abnormally large decreases in outflows of people include Les Cayemites And Espere.
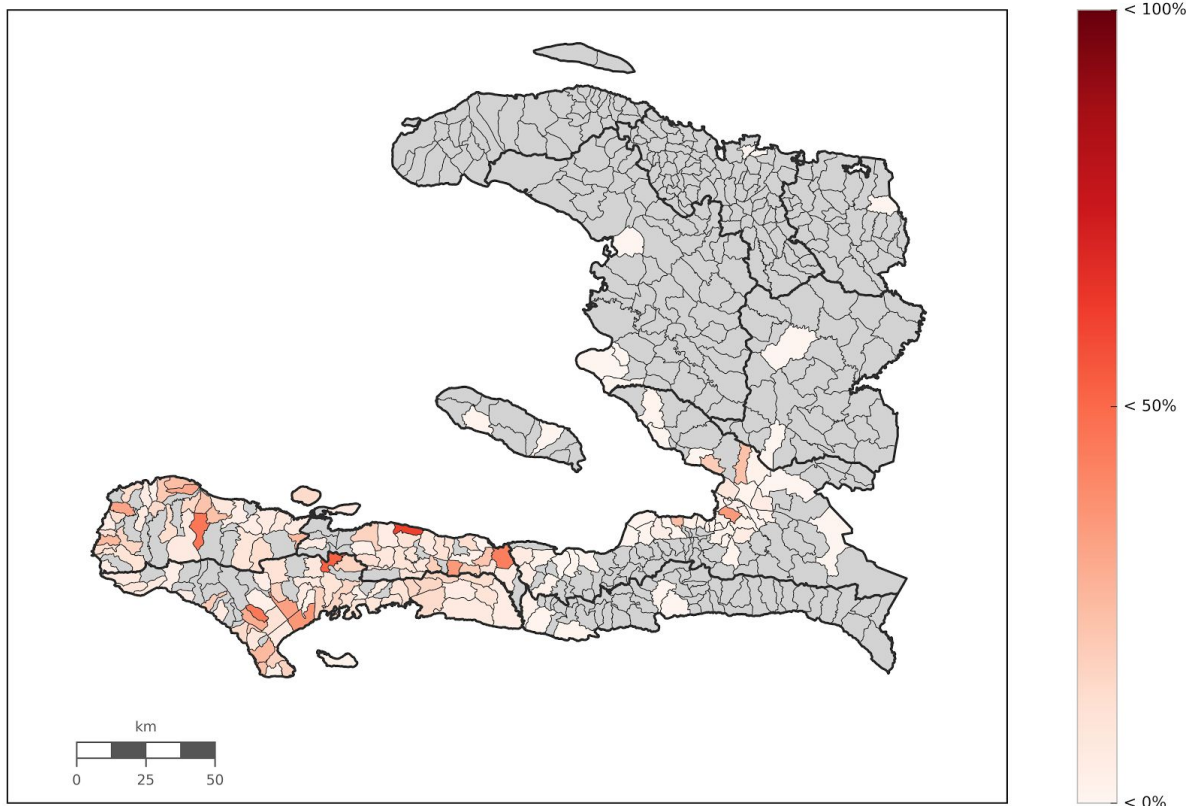
Population Inflows

Flows relative to the population
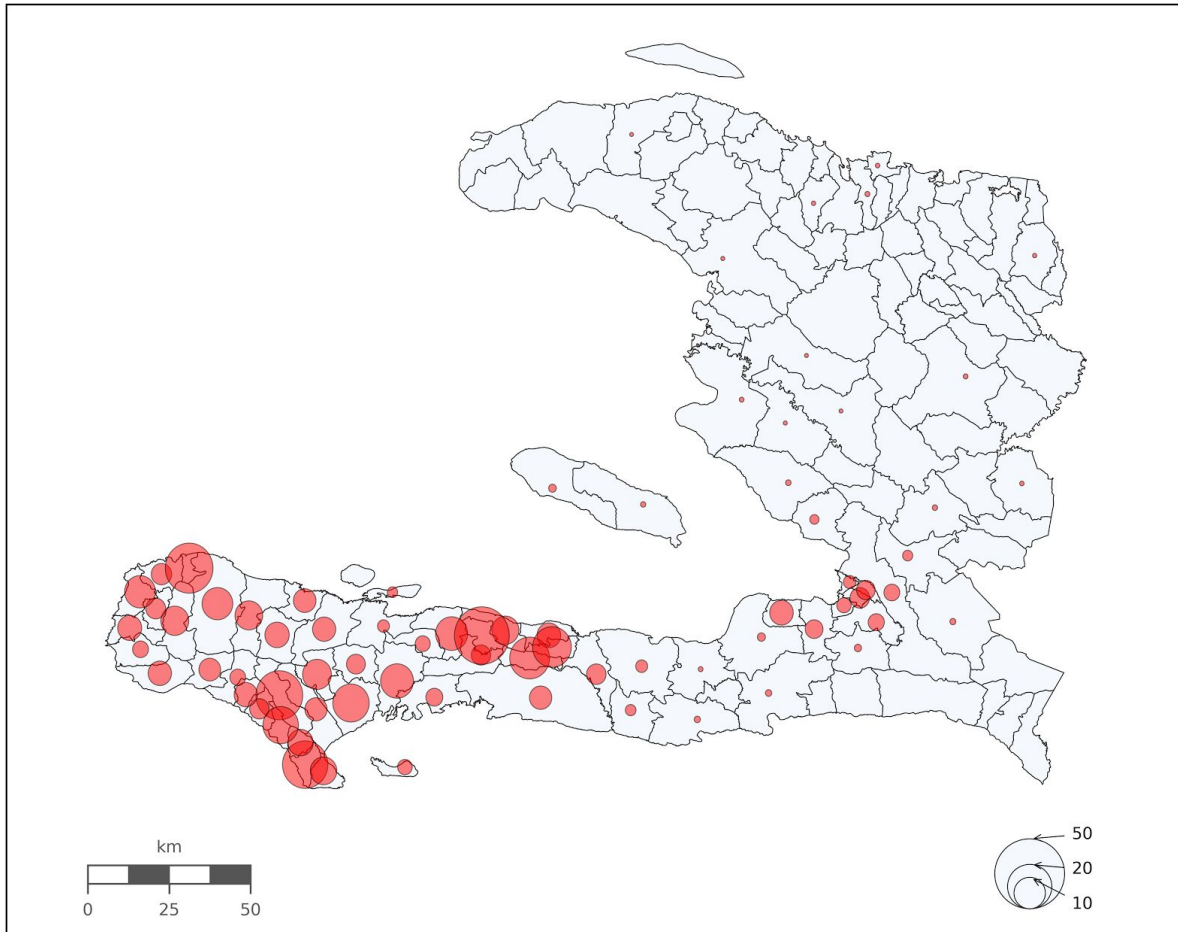
Map 7: Population increase (percent) per Commune due to inflow from affected Departments. Out of those who lived pre-hurricane in the Departments of Sud, Grande Anse and Nippes and who left their homes after the hurricane, the number of arriving phones per Commune is first determined. This number is subsequently divided by the total pre-hurricane population of the Commune.

The movements of mobile subscribers indicate that some Communes have received large numbers of arrivals relative to their normal population. The Communes of Arnaud, Bonbon and Chantal experienced the most people arriving relative to their normal populations.

Map 8: Population increase (percent) per Section Communale due to inflow from affected Departments (as Map 7 but on the level of Section Communale). Out of those who lived pre-hurricane in the Departments of Sud, Grande Anse and Nippes and who left their homes after the hurricane, the number of arriving phones per Section Communale is first determined. This number is subsequently divided by the total pre-hurricane population of the Section Communale.

The Section Communales of Baconnois, Larogue and Haute Voldrogue experienced the most people arriving relative to their normal populations.

Absolute flows
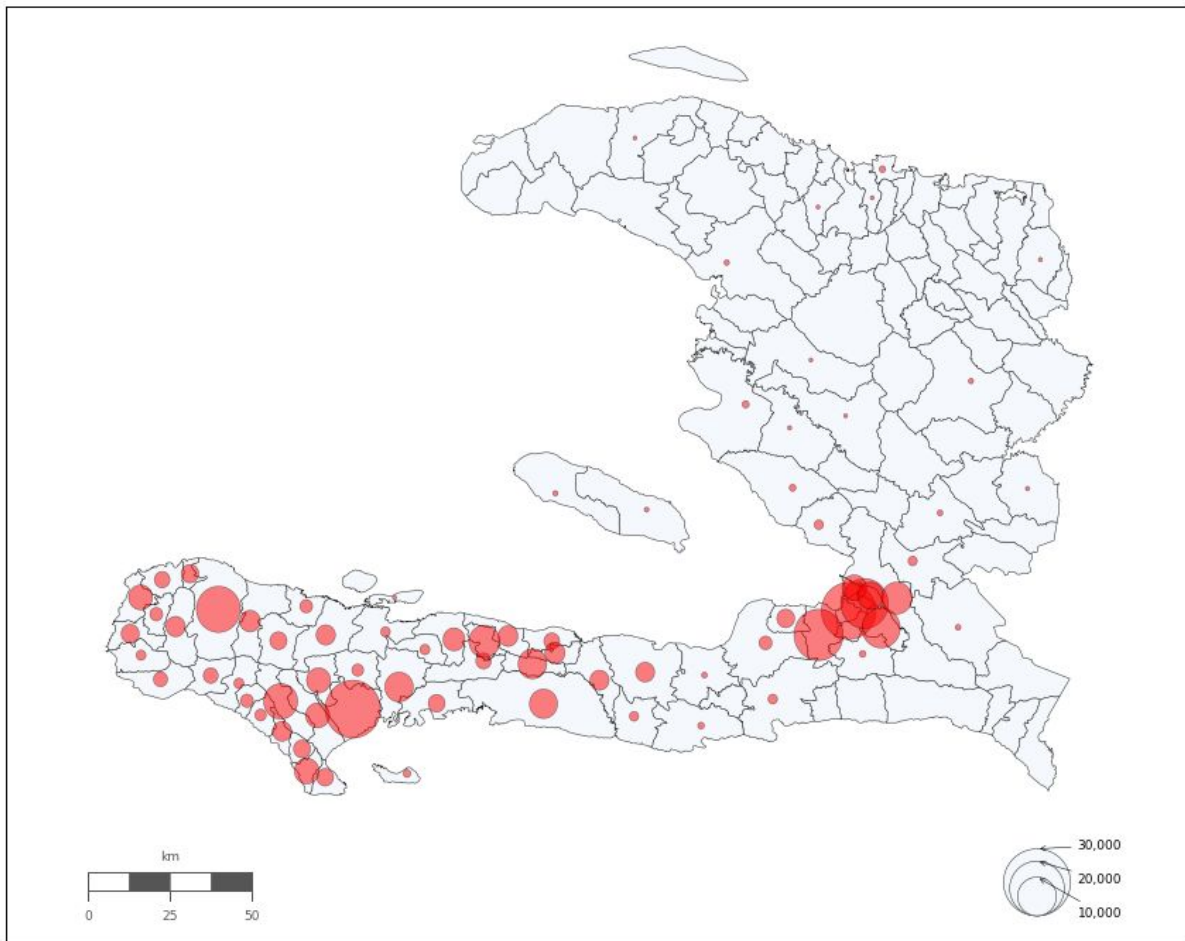
Map 9: Estimated number of people who arrived into Communes from the Departments of Sud, Grande Anse and Nippes.

Large movements are seen towards urban areas, including the Port-au-Prince metropolitan area, Jeremie and Les Cayes. The movements towards Port-au-Prince may be important in relation to potential spread of cholera from the affected departments.
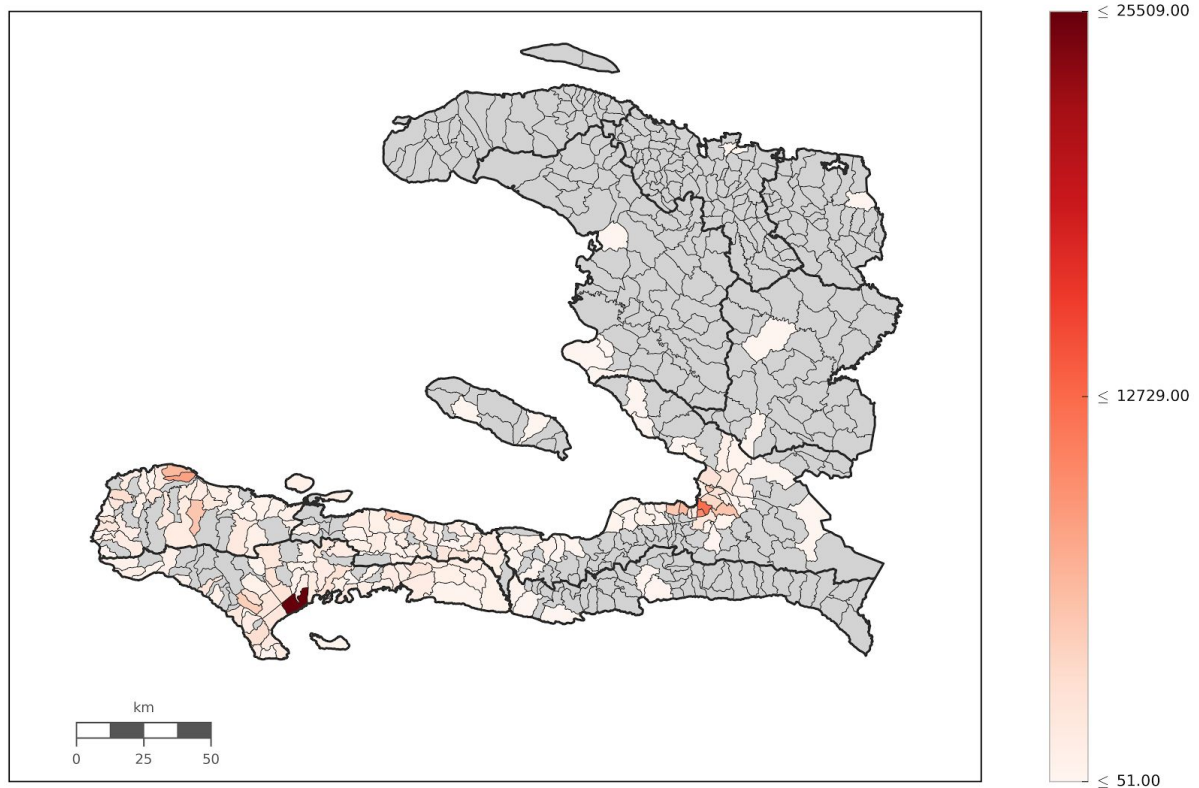
Map 10: Estimated number of people who arrived into Section Communales from the Departments of Sud, Grande Anse and Nippes.
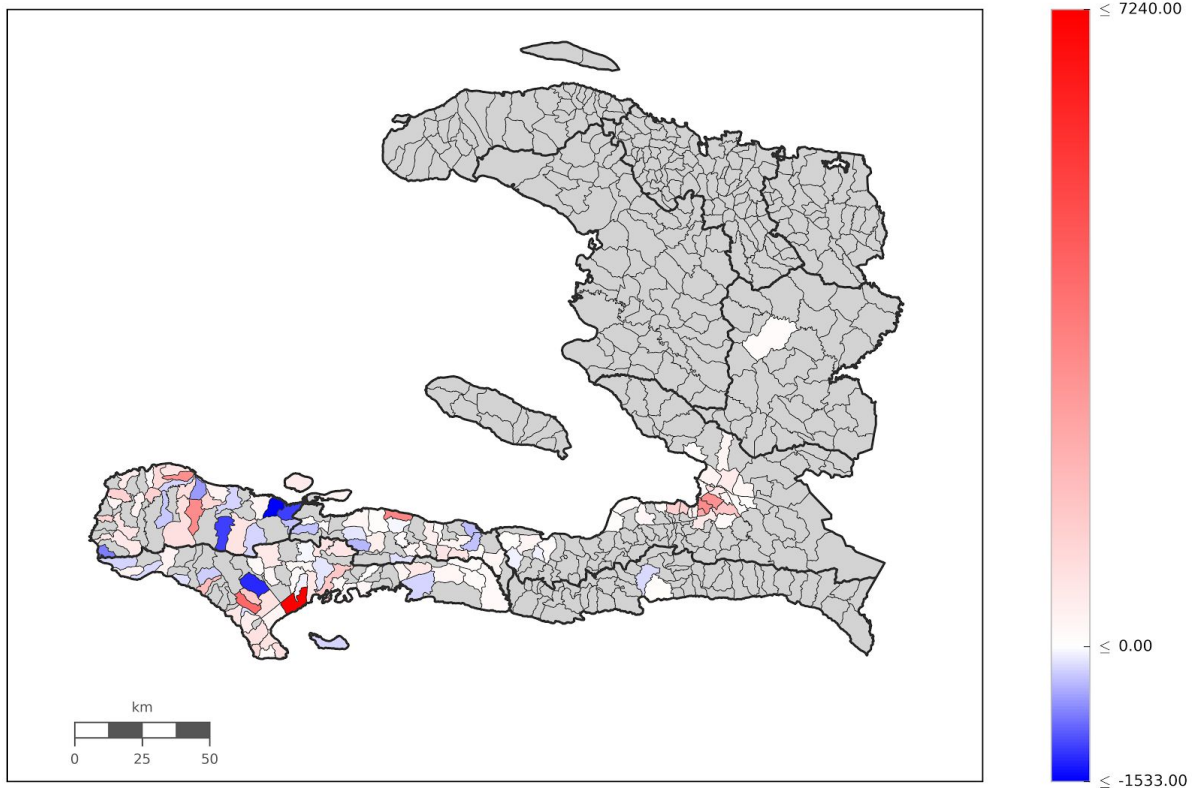
As seen at the Commune level, large movements are seen towards the urban centres.

Flows above normal
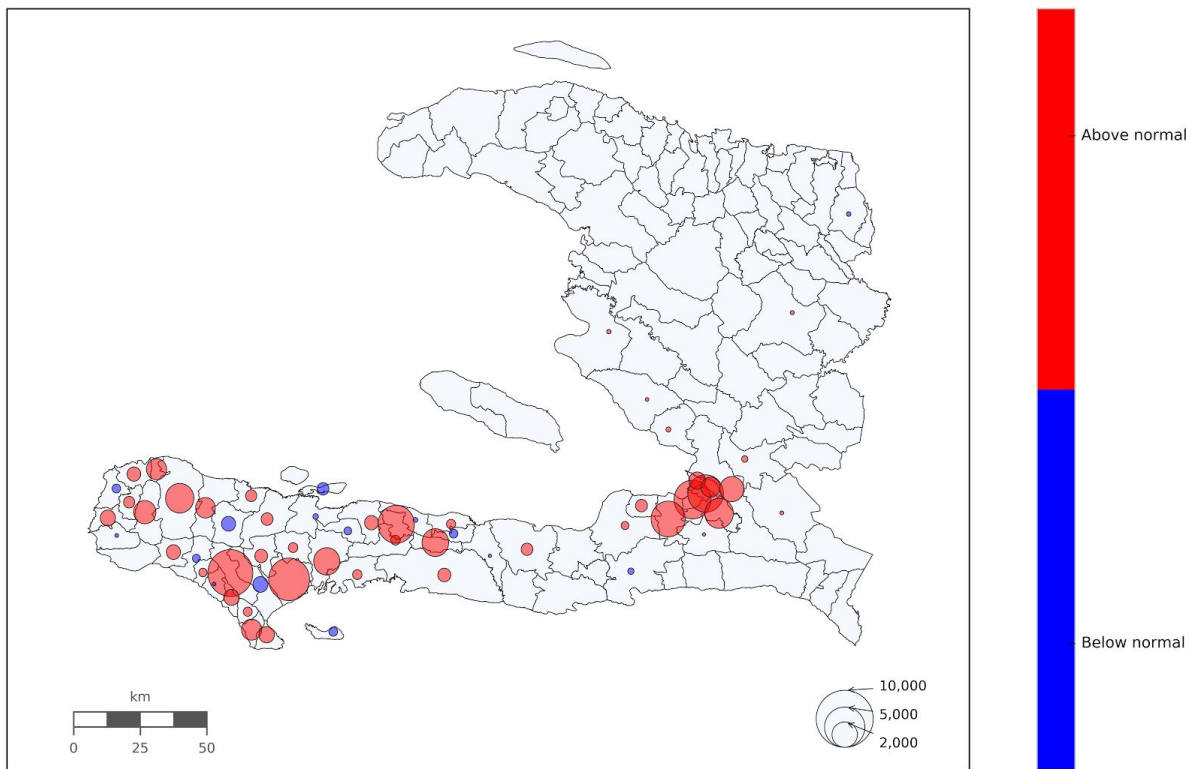
Map 11: Estimated number of people compared to normal, who arrived into Communes from the Departments of Sud, Grande Anse and Nippes.

The strong increase in flows above normal across the region indicates disruption to the normal patterns of population movement. Communes experiencing abnormally large increases in inflows of people include Chantal, Les Cayes and Arnaud, plus the Port-au-Prince metropolitan area.

Map 12: Estimated number of people compared to normal, who arrived into Section Communales from the Departments of Sud, Grande Anse and Nippes.

Similar to the Commune level, a large variation in flows above normal is seen at the Section Communale level. Section Communales experiencing abnormally large increases in inflows of people include Bourdet, Veroniere, and Baconnois. Those experiencing abnormally large decreases in inflows of people include Bernagousse and Solon.