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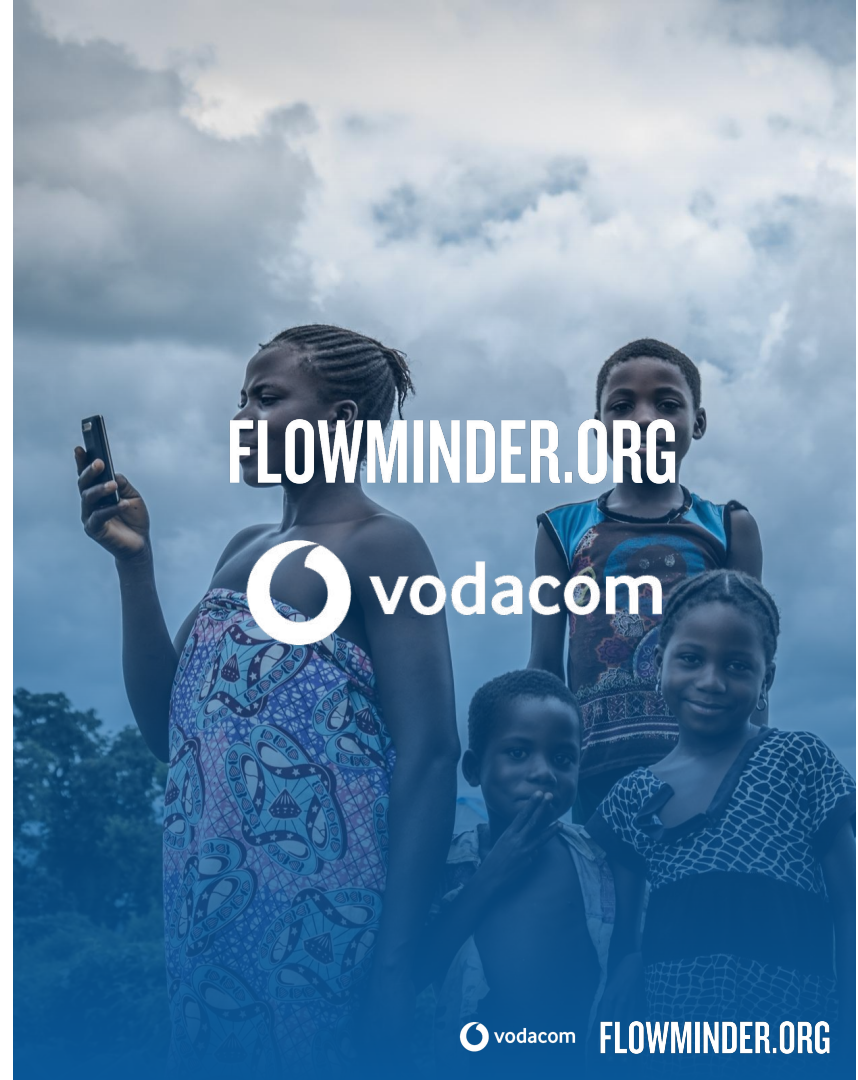
Eruption of Mount Nyiragongo

Estimating population
displacement using mobile
operator data (Call Detail Records)

Flowminder Foundation
Vodacom RDC

Authors

This work was led and produced by the Flowminder Foundation and Vodacom RDC.



Executive summary

The Mount Nyiragongo erupted on May 22, 2021. Although the time for emergency response has passed, the estimated scale of population movements suggests that recovery from this disaster and a return to normal may require significant efforts over the coming weeks and months.

Mobility analyses conducted by Flowminder and Vodacom RDC can help monitor the return to normal and provide essential information to support decisions related to where allocating resources for displaced people efficiently.

The difference between estimated inflows and outflows suggests that a large number of the displaced people had not yet returned to Goma by the 4th of June (the end of the period of analysis). Departures for each of the three major travel routes (from Goma to Bukavu, to Rutshuru-Butembo, and to Sake-Masisi) truly began only on May 27, the day of the evacuation of Goma. By June 4, no mass return to Goma is observed and subscribers presence is above the baseline period in Bukavu, Rutshuru, Butembo, and Sake and Masisi. This suggests that large numbers of displaced people had not yet returned to Goma.

Vulnerability to cholera outbreaks throughout the affected areas is a major public health concern despite several vaccination campaigns in 2019 and 2020. Other infectious diseases may also spread more widely than in the past and hence require closer monitoring. Over the coming weeks and months, mobility data can play a key role in this effort.



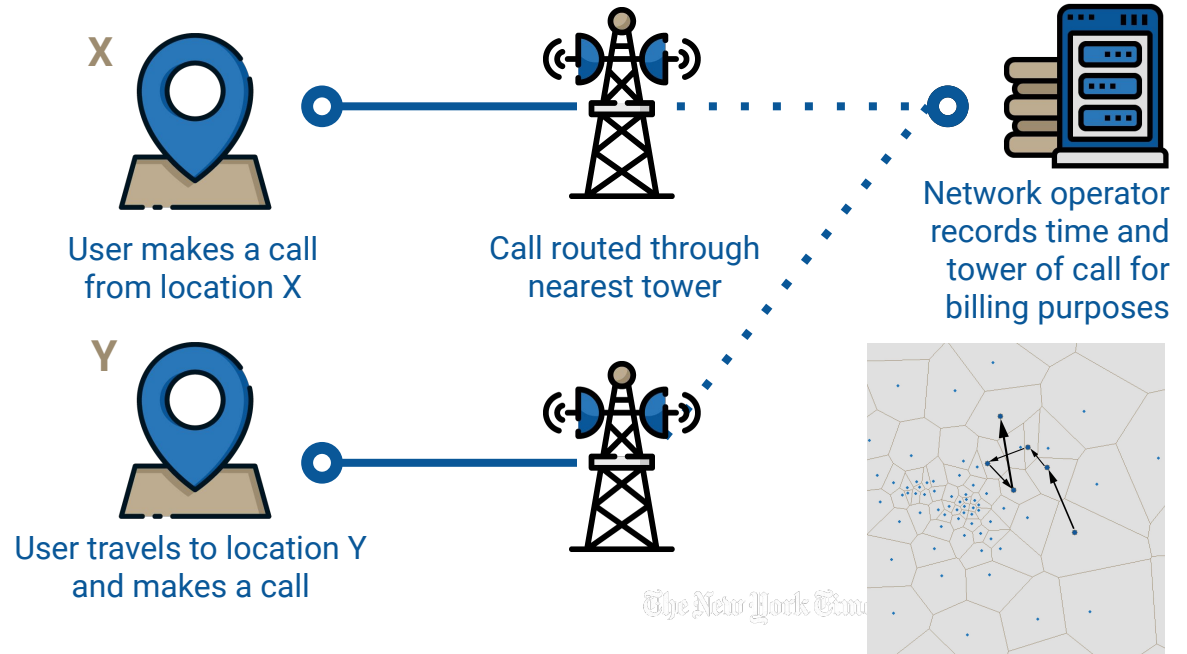
Data sources, period of analysis, area of focus and data privacy

We provide a brief overview of the mobility data that was used, define the period of analysis and the area of focus, and summarize the measures to protect data privacy.

Introduction to mobile operator data

Call Detail Records (CDR data)

- Stations/towers with several cells
- Mobile operators maintain a database of CDRs for billing purposes
- A record is generated every time a subscriber makes or receives a call or SMS or uses mobile data
- For analysis, neighbouring towers are grouped together into *clusters* to avoid signal rerouting being interpreted as a change of location.

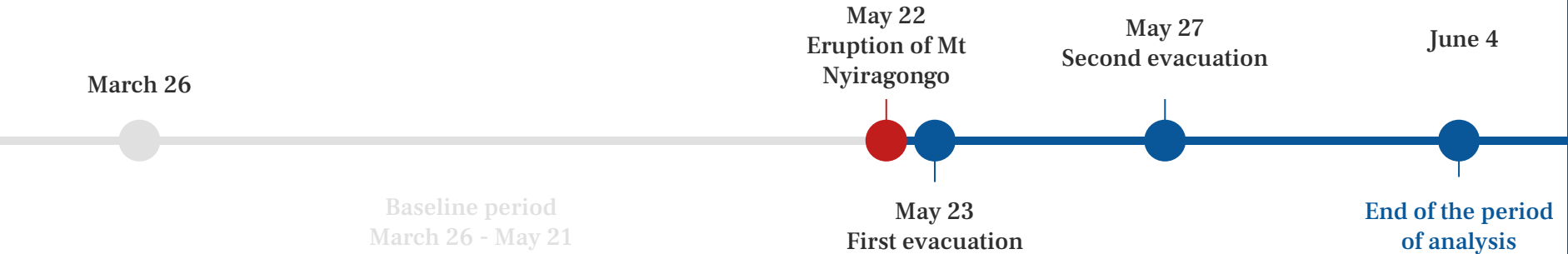


Period of analysis and data sources

Key dates

- Baseline period: March 26 - May 21
- Comparison period: May 22 - June 4

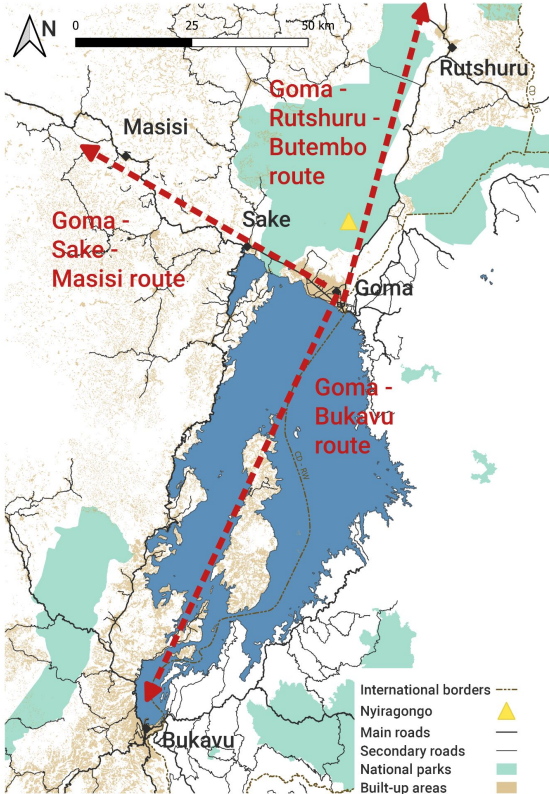
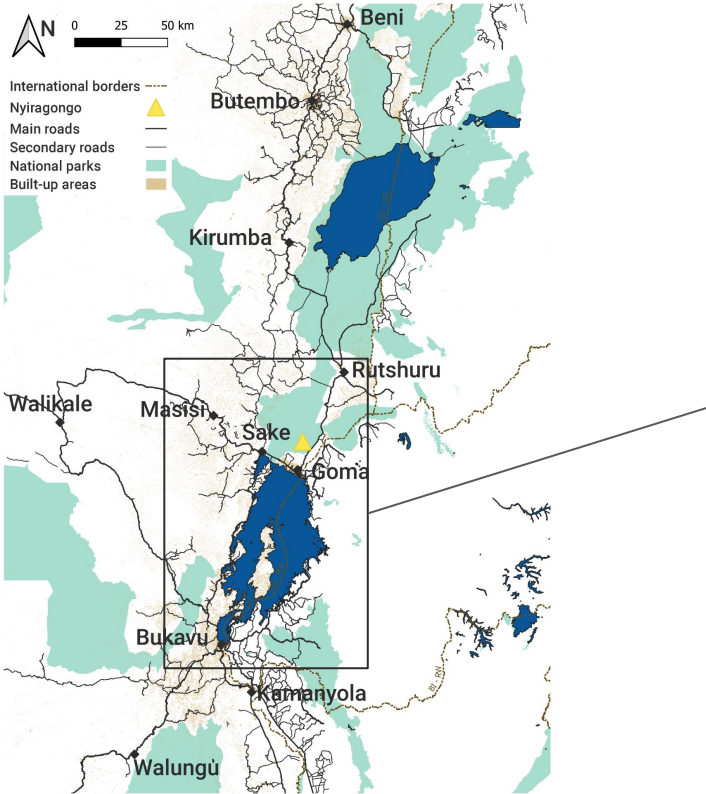
Reading graphs and maps: Some results are expressed as percentage change from the pre-eruption baseline period median, i.e. as percentage change from normal conditions. The timeline below summarises the analysis period.



Data source: Vodacom RDC provided the CDR data used in this analysis.

Limitations: These results are preliminary. A subscriber's location is only determined when they make or receive a call/SMS or start a mobile data session. These numbers are therefore limited to the portion of subscribers who were "active" in particular locations in a 24-hour period. If the number of active subscribers increased due to the eruption and more people made calls, the increase in subscribers presence, entries and exits from areas and flows in comparison with baseline may be overestimated. In addition, the same subscriber, if located in several locations during the same 24h period, may be counted in several locations, entries and exits or flows.

Focus areas



Data privacy and “do no harm”

The key principles of Flowminder and Vodacom RDC:

- Individual subscriber metadata remain with the Vodacom protected behind its firewall
- Individual subscriber trajectories are never viewed by Flowminder analysts, and never shared
- All results are anonymised: the aggregated statistics of cell phone metadata do not allow for the identification of subscribers.
- Analysis methods and detailed descriptions of results are provided to the users to avoid possible misinterpretation

An aerial photograph of a vast, densely populated city, likely in East Africa, with a large volcano (Mt Nyiragongo) visible in the background under a cloudy sky. The image is overlaid with a semi-transparent blue filter.

Wave of displacement

In this section, we map the changes in subscribers presence measured in the days following the eruption of Mt Nyiragongo. The numbers are expressed as a percent change in comparison with the baseline period.

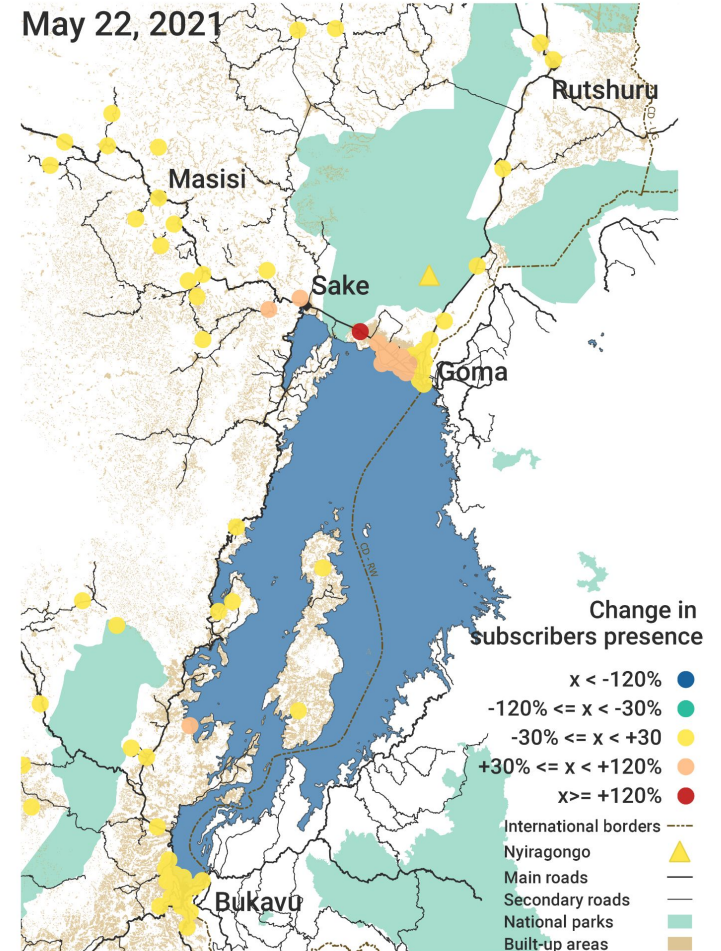
Change in subscribers presence - May 22: day of the eruption

Definition

Percent change relative to baseline of the number of subscribers located in a cluster during a 24h period

Reading the map Each dot shows the central location of cell towers grouped in a cluster (each cluster may stretch over several kilometers). The redder the dot, the higher the presence of subscribers compared to the baseline period. The bluer the dot, the lower the presence.

Interpretation. Overall, presence is within normal range, except in the western part of Goma and exit in direction of Sake.



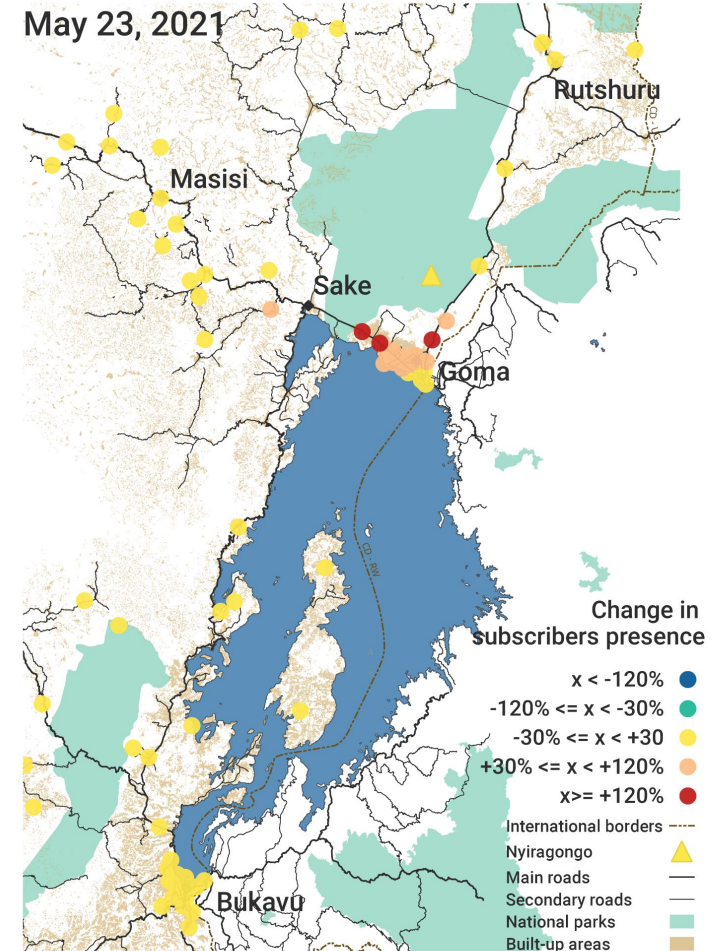
Change in subscribers presence - May 23

Definition

Percent change relative to baseline of the number of subscribers located in a cluster during a 24h period

Reading the map Each dot shows the central location of cell towers grouped in a cluster (each cluster may stretch over several kilometers). The redder the dot, the higher the presence of subscribers compared to the baseline period. The bluer the dot, the lower the presence.

Interpretation. Overall, presence is within normal range, except in the western and northern neighbourhoods of Goma and exits in direction of Sake and Rutshuru.



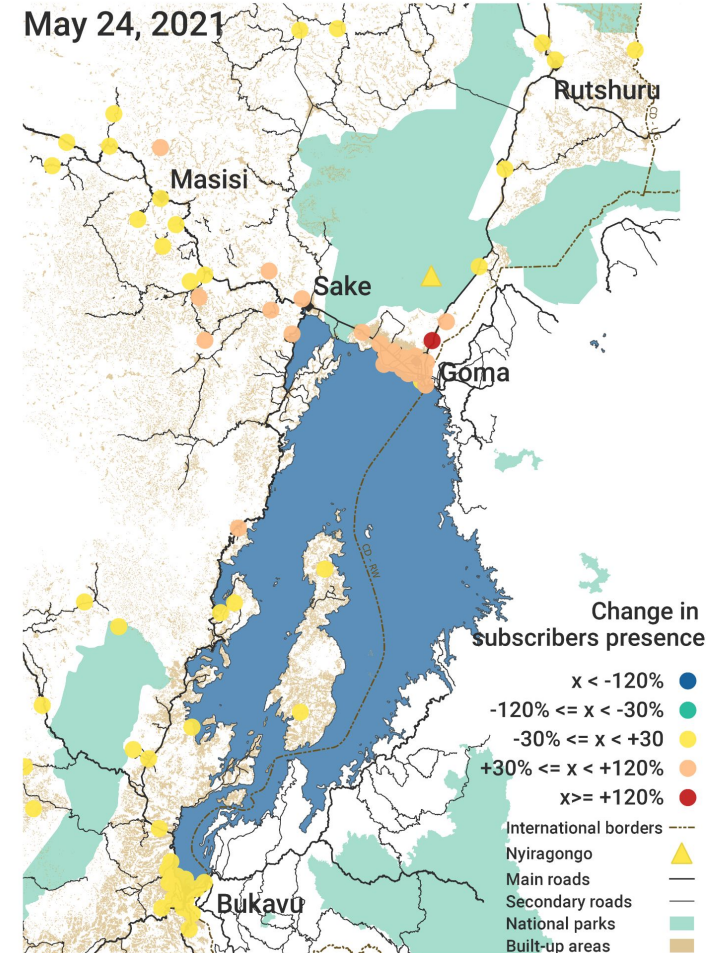
Change in subscribers presence - May 24

Definition

Percent change relative to baseline of the number of subscribers located in a cluster during a 24h period

Reading the map Each dot shows the central location of cell towers grouped in a cluster (each cluster may stretch over several kilometers). The redder the dot, the higher the presence of subscribers compared to the baseline period. The bluer the dot, the lower the presence.

Interpretation. Presence and traffic remain higher than usual in Goma and increase in Sake and beyond, toward Masisi and Bukavu. North of Goma, presence and traffic are particularly high where the N2 has been cut through by the initial lava flow.



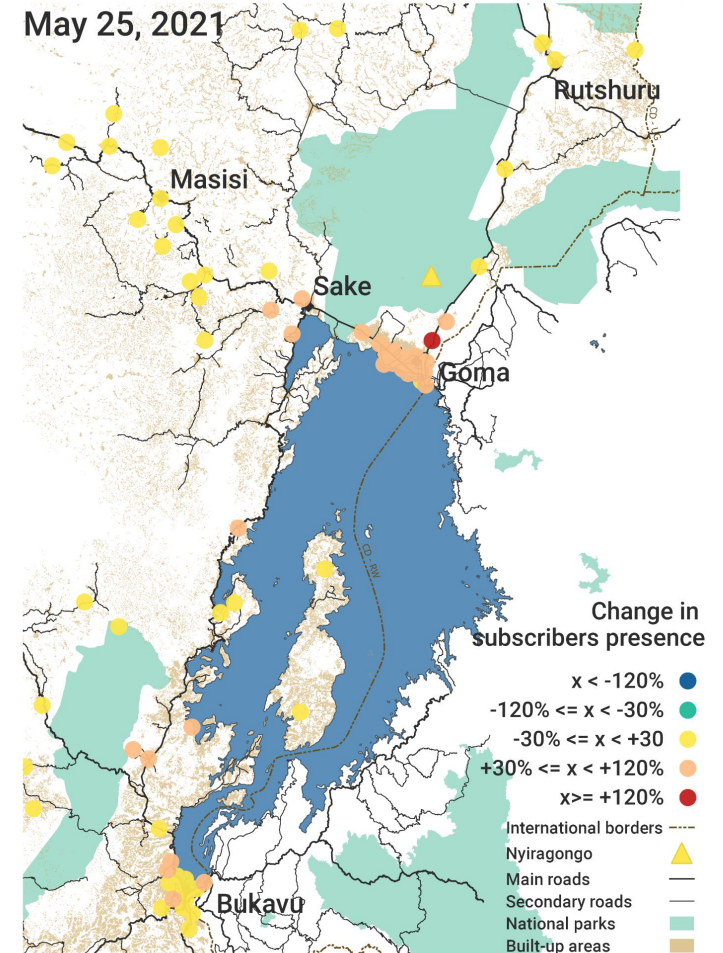
Change in subscribers presence - May 25

Definition

Percent change relative to baseline of the number of subscribers located in a cluster during a 24h period

Reading the map Each dot shows the central location of cell towers grouped in a cluster (each cluster may stretch over several kilometers). The redder the dot, the higher the presence of subscribers compared to the baseline period. The bluer the dot, the lower the presence.

Interpretation. Like the day before, presence and traffic remain higher than usual in Goma and around Sake. The same can be observed in direction of and near Bukavu. North of Goma, presence and traffic remain high where the N2 has been cut, but not beyond.



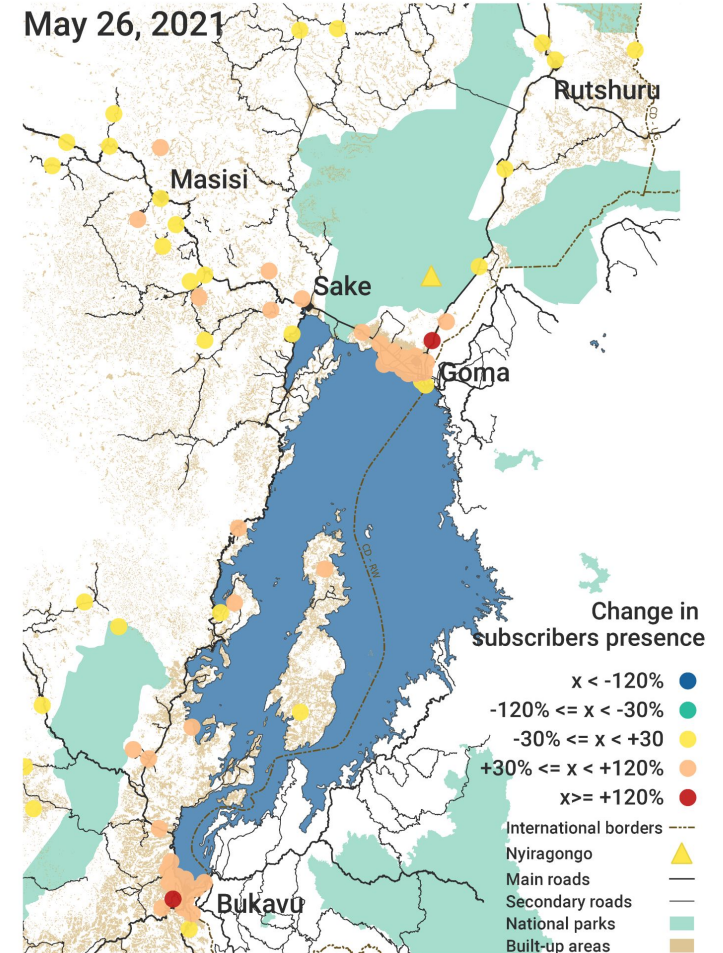
Change in subscribers presence - May 26

Definition

Percent change relative to baseline of the number of subscribers located in a cluster during a 24h period

Reading the map Each dot shows the central location of cell towers grouped in a cluster (each cluster may stretch over several kilometers). The redder the dot, the higher the presence of subscribers compared to the baseline period. The bluer the dot, the lower the presence.

Interpretation. As observed the two previous days, presence and traffic remain higher than usual in Goma and around Sake and Masisi. The same phenomenon is observed in the area between Sake and Bukavu, and in Bukavu itself. North of Goma, presence and traffic remain high where the N2 has been cut, but not beyond.



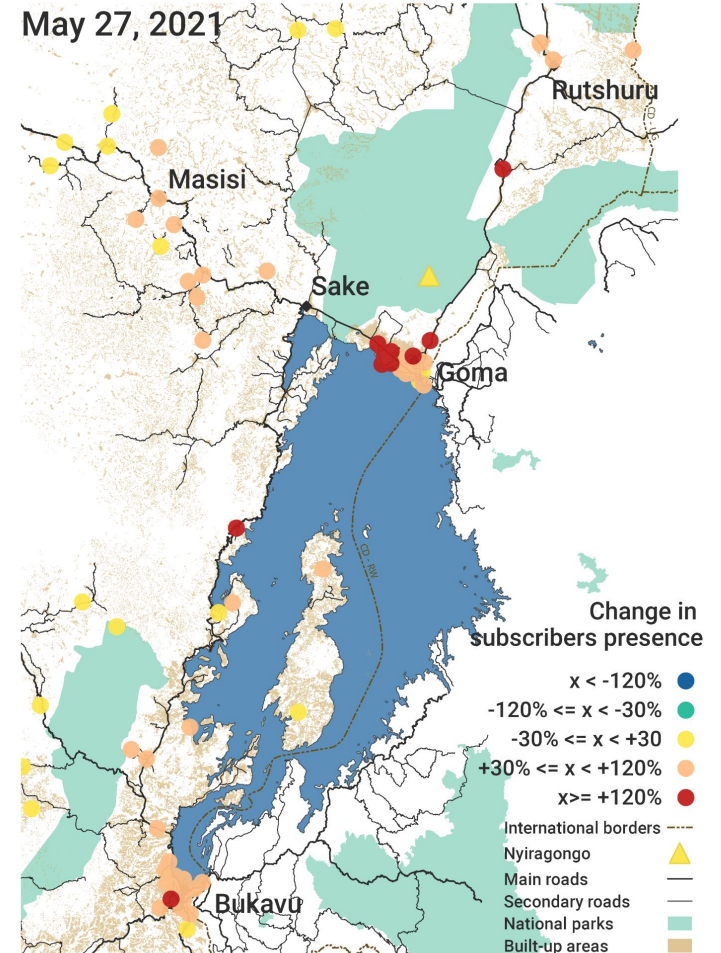
Change in subscribers presence - May 27: Evacuation order

Definition

Percent change relative to baseline of the number of subscribers located in a cluster during a 24h period

Reading the map Each dot shows the central location of cell towers grouped in a cluster (each cluster may stretch over several kilometers). The redder the dot, the higher the presence of subscribers compared to the baseline period. The bluer the dot, the lower the presence.

Interpretation. On the day of the evacuation order, presence and traffic increase noticeably in peripheral neighbourhoods of Goma and in all directions, towards Masisi, Bukavu and Rutshuru. Traffic on the N2 was re-established beyond the lava caused damages and presence and traffic in areas surrounding Rutshuru increase for the first time since the eruption.



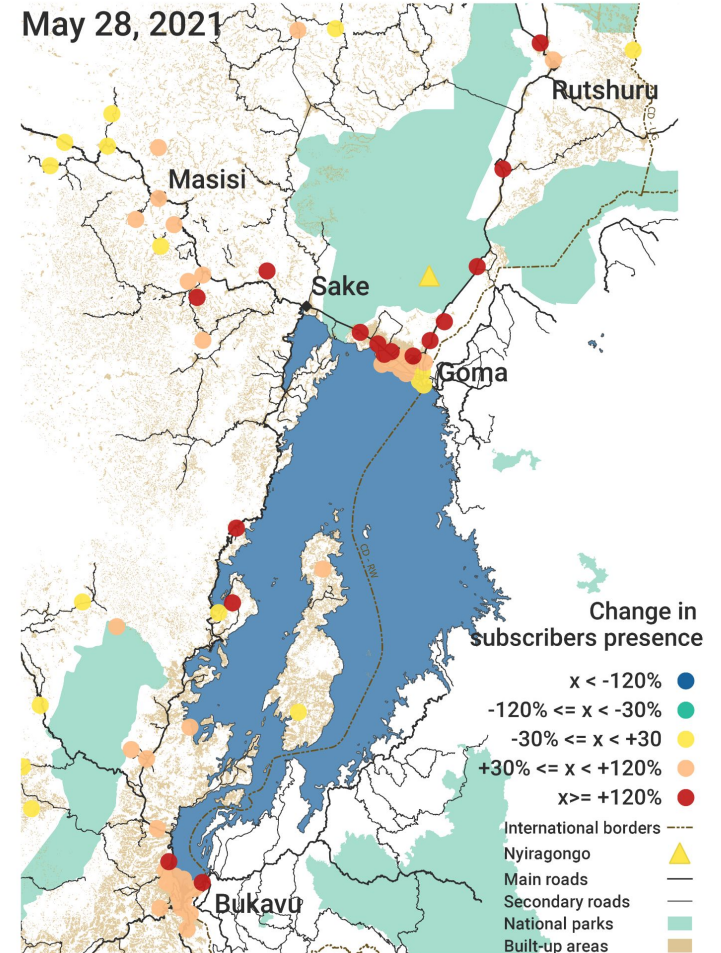
Change in subscribers presence - May 28

Definition

Percent change relative to baseline of the number of subscribers located in a cluster during a 24h period

Reading the map Each dot shows the central location of cell towers grouped in a cluster (each cluster may stretch over several kilometers). The redder the dot, the higher the presence of subscribers compared to the baseline period. The bluer the dot, the lower the presence.

Interpretation. Presence and traffic on all routes out of Goma is much higher than usual. This large increase is also observed in Rutshuru and Bukavu.



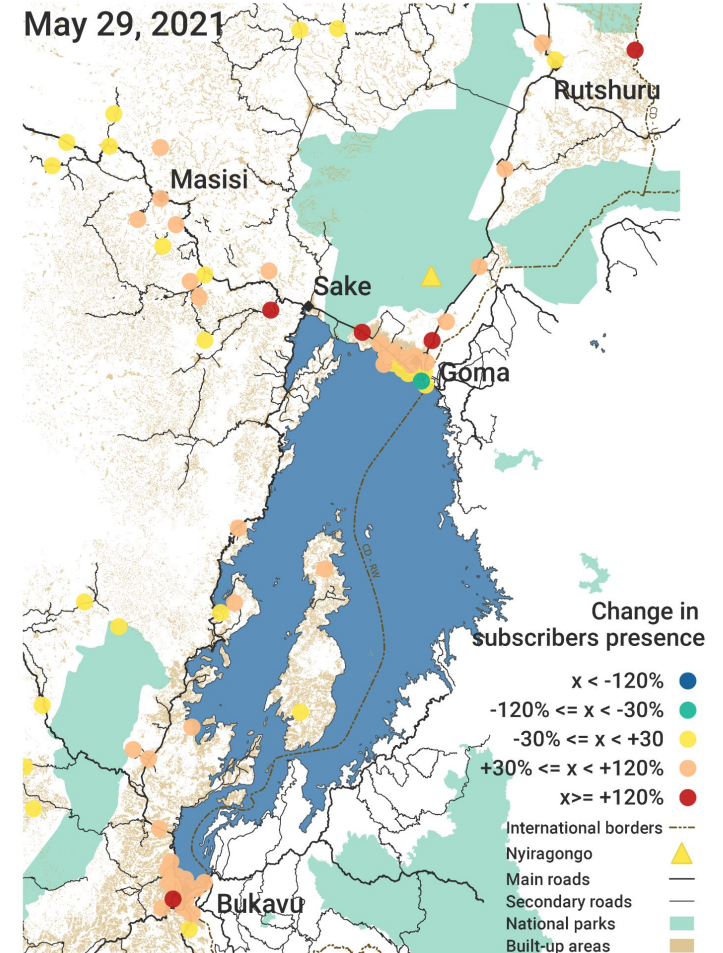
Change in subscribers presence - May 29

Definition

Percent change relative to baseline of the number of subscribers located in a cluster during a 24h period

Reading the map Each dot shows the central location of cell towers grouped in a cluster (each cluster may stretch over several kilometers). The redder the dot, the higher the presence of subscribers compared to the baseline period. The bluer the dot, the lower the presence.

Interpretation. Presence and traffic in the centre of Goma is lower than usual for the first time, but they remain high in peripheral neighbourhoods towards north and west. Presence and traffic on all routes out of Goma are less high than the previous day, but remain higher than normal.



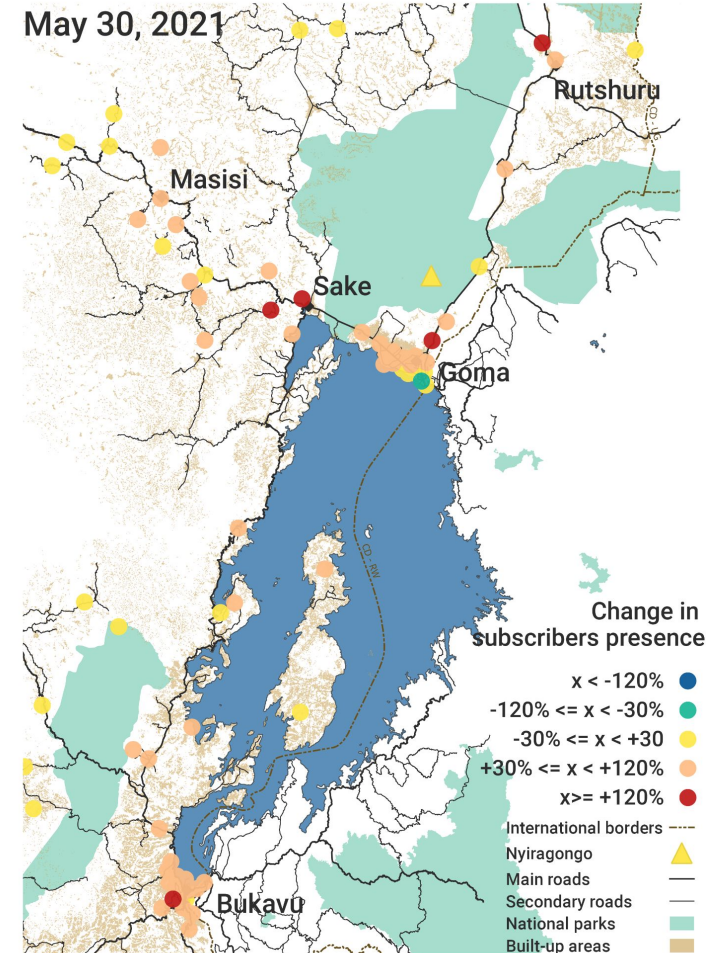
Change in subscribers presence - May 30

Definition

Percent change relative to baseline of the number of subscribers located in a cluster during a 24h period

Reading the map Each dot shows the central location of cell towers grouped in a cluster (each cluster may stretch over several kilometers). The redder the dot, the higher the presence of subscribers compared to the baseline period. The bluer the dot, the lower the presence.

Interpretation. Little change compared to the previous day. Presence and traffic is overall higher than usual, especially around Sake and Rutshuru.



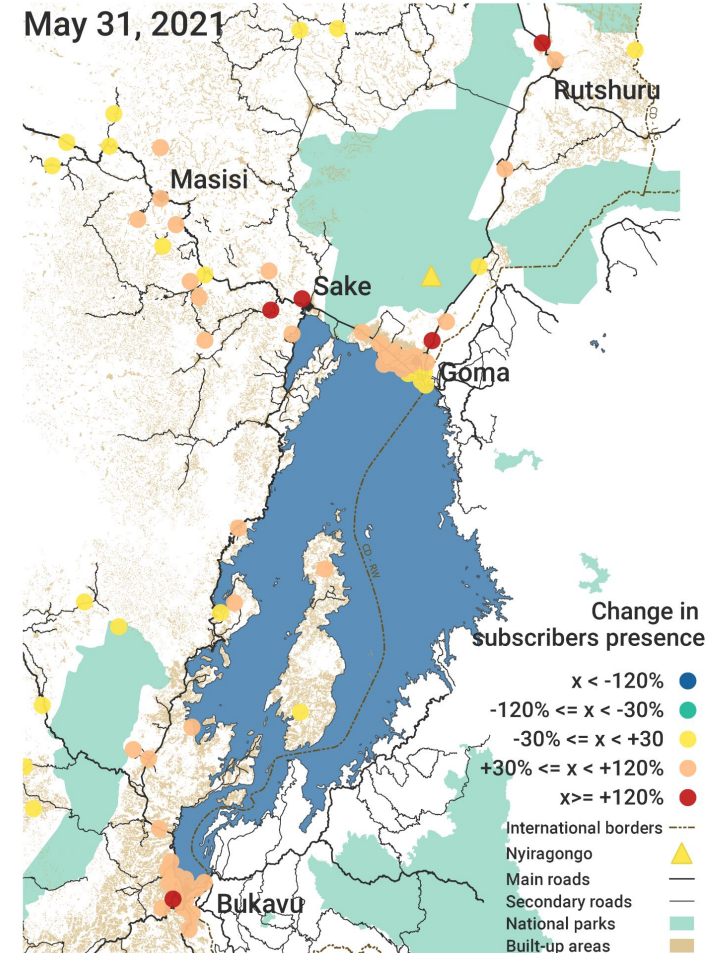
Change in subscribers presence - May 31

Definition

Percent change relative to baseline of the number of subscribers located in a cluster during a 24h period

Reading the map Each dot shows the central location of cell towers grouped in a cluster (each cluster may stretch over several kilometers). The redder the dot, the higher the presence of subscribers compared to the baseline period. The bluer the dot, the lower the presence.

Interpretation. Little change compared to the previous day. Presence and traffic is overall higher than usual, especially around Sake and Rutshuru. Traffic and presence in the centre of Goma appears to get back within the normal range.



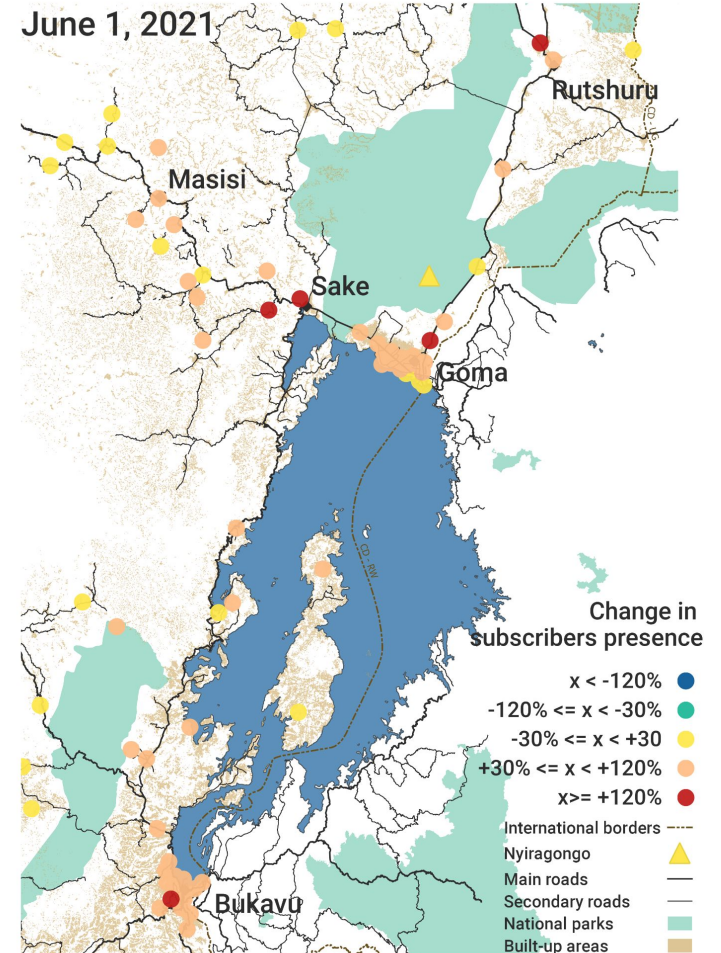
Change in subscribers presence - June 1

Definition

Percent change relative to baseline of the number of subscribers located in a cluster during a 24h period

Reading the map Each dot shows the central location of cell towers grouped in a cluster (each cluster may stretch over several kilometers). The redder the dot, the higher the presence of subscribers compared to the baseline period. The bluer the dot, the lower the presence.

Interpretation. As observed the previous days, presence and traffic are higher than normal on all routes out of Goma and in peripheral neighbourhoods of Goma, in Sake, Bukavu and Rutshuru.



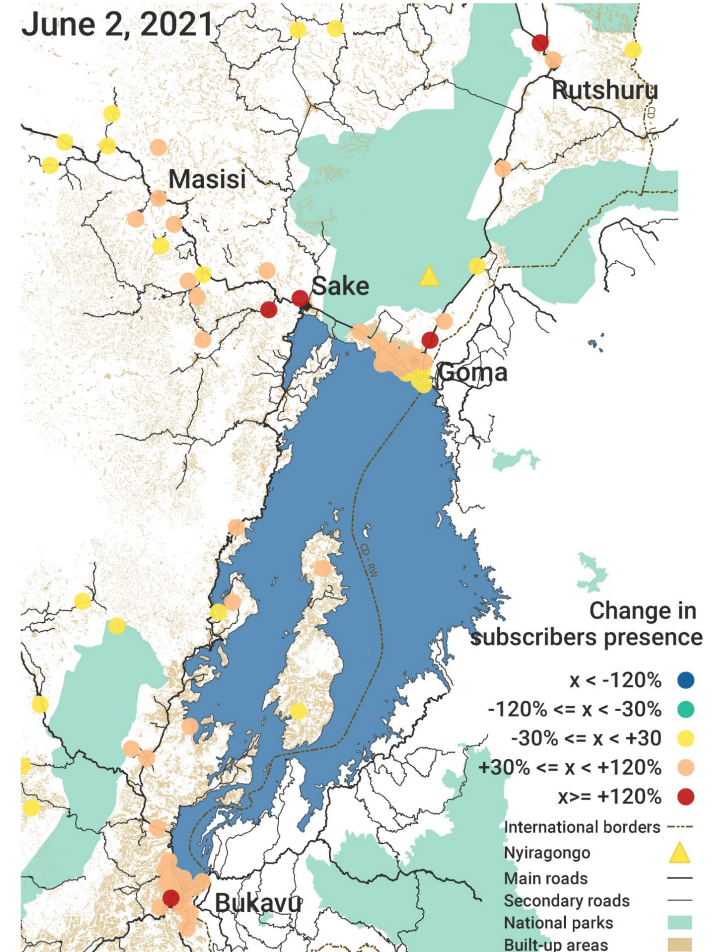
Change in subscribers presence - June 2

Definition

Percent change relative to baseline of the number of subscribers located in a cluster during a 24h period

Reading the map Each dot shows the central location of cell towers grouped in a cluster (each cluster may stretch over several kilometers). The redder the dot, the higher the presence of subscribers compared to the baseline period. The bluer the dot, the lower the presence.

Interpretation. Little change compared to the previous day.



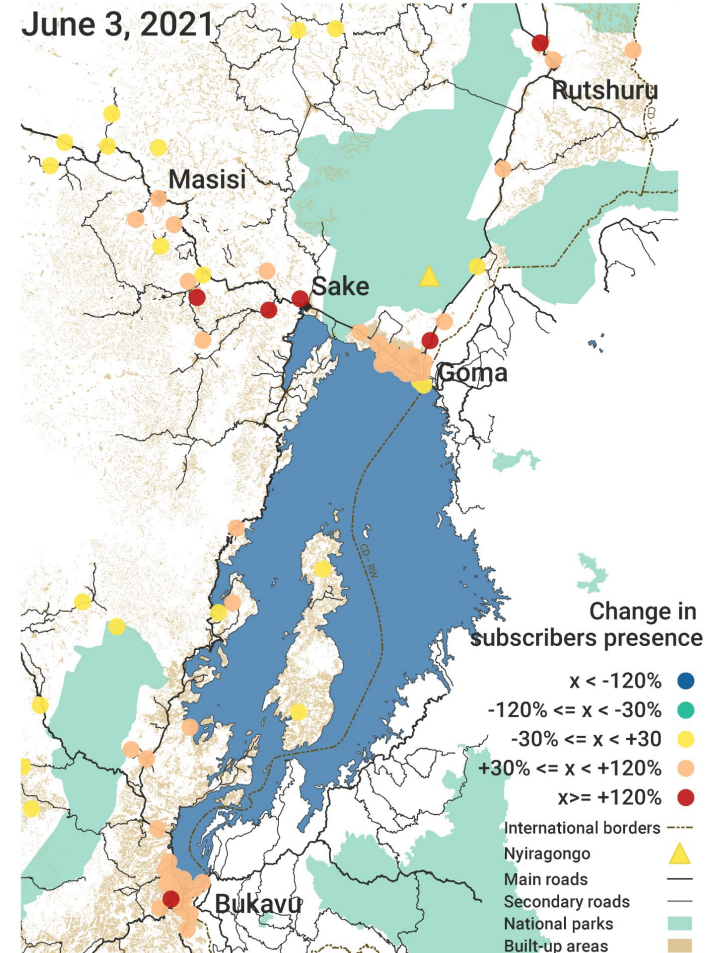
Change in subscribers presence - June 3

Definition

Percent change relative to baseline of the number of subscribers located in a cluster during a 24h period

Reading the map Each dot shows the central location of cell towers grouped in a cluster (each cluster may stretch over several kilometers). The redder the dot, the higher the presence of subscribers compared to the baseline period. The bluer the dot, the lower the presence.

Interpretation. The same trends can be observed since the 31st of May. presence and traffic are higher than normal on all routes out of Goma, but especially near Sake, Rutshuru and Rubaya. Traffic and presence in the centre of Goma remains within the normal range but peripheral neighbourhoods still experience higher presence and traffic than normal.



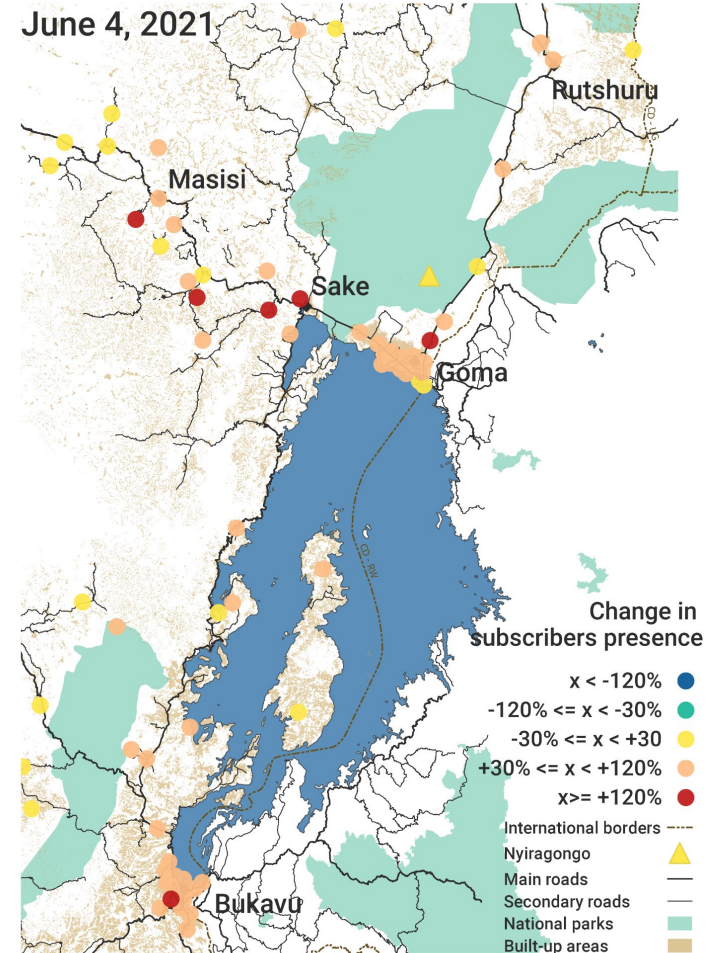
Change in subscribers presence - June 4

Definition

Percent change relative to baseline of the number of subscribers located in a cluster during a 24h period

Reading the map Each dot shows the central location of cell towers grouped in a cluster (each cluster may stretch over several kilometers). The redder the dot, the higher the presence of subscribers compared to the baseline period. The bluer the dot, the lower the presence.

Interpretation. Little change compared to the previous day.

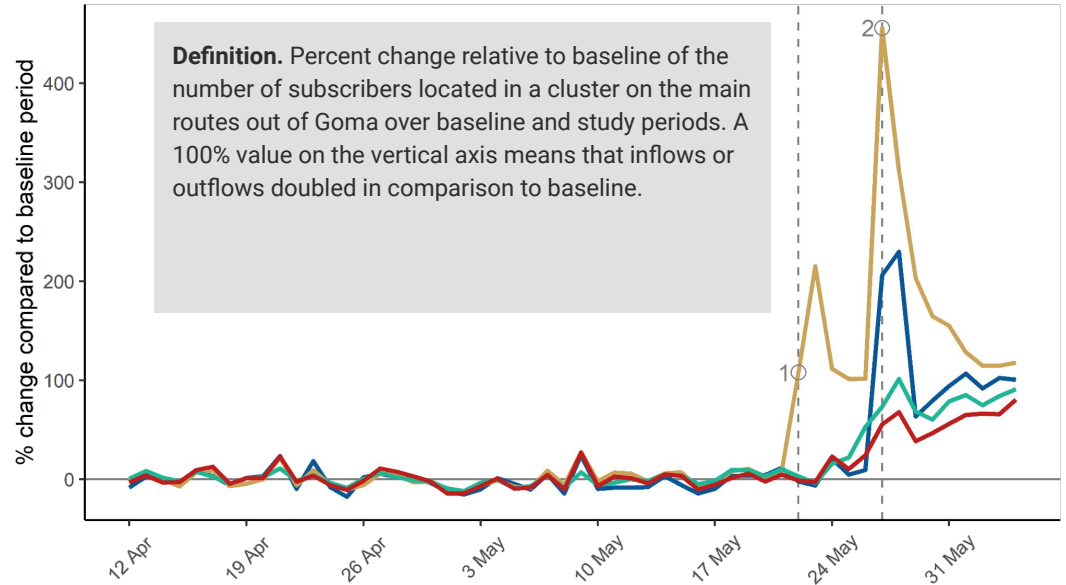


Subscribers presence on the main routes out of Goma

Reading the graph: The horizontal axis represents time whilst the vertical one represents percent change compared to baseline. The lines show presence and traffic on the main routes out of Goma. A 100% increase means that presence and traffic doubled in comparison with the baseline.

Interpretation. It's on the Goma - Sake route that presence and traffic most increased on the day of the eruption and then on the day of the evacuation order. The second highest increase was observed on the route towards Rutshuru on the day of evacuation. On the Sake-Bukavu and Sake-Masisi routes, presence and traffic peaked on the day following the evacuation, at nearly double the usual.

Key dates: (1) May 22: Eruption of Mount Nyiragongo; (2) May 27: Evacuation of Goma



Axe: ■ Goma-Rutshuru ■ Goma-Sake ■ Sake-Bukavu ■ Sake-Masisi

Data sources: Vodacom RDC

An aerial photograph of a densely populated city, likely Goma, with a large volcano in the background under a cloudy sky. The image is overlaid with a blue gradient.

Flows of subscribers on the main travel routes caused by the eruption

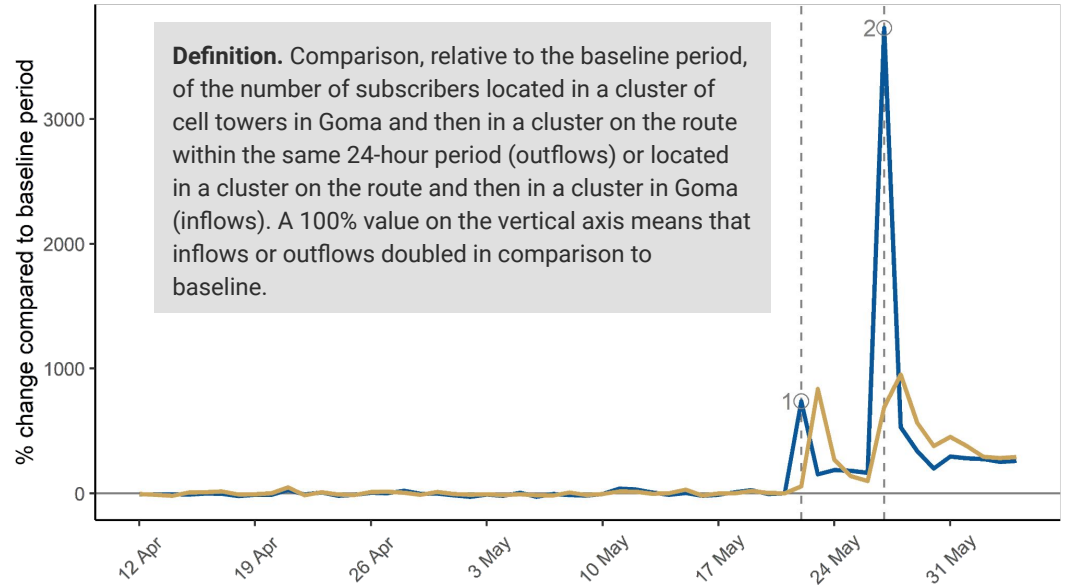
In this section, we examine the flows on the Goma-Bukavu, Goma-Sake-Masisi and Goma-Rutshuru routes over time.

Goma - Sake route

Reading the graph: The horizontal axis represents time whilst the vertical one represents percent change compared to baseline. The blue line shows outflows from Goma towards Sake, and the gold line inflows into Goma from Sake. A 100% value on the vertical axis means that inflows or outflows doubled in comparison to baseline.

Interpretation. Outflows from Goma in direction of Sake already increase noticeably on the day of the eruption (more than 10 times more than usual) and inflows back to Goma start the next day. Numbers return nearly to normal until the evacuation order, when outflows towards Sake peak to 35 times more than usual. Inflows back to Goma increase already the next day and both in and outflows then remain higher than normal.

Key dates: (1) May 22: Eruption of Mount Nyiragongo; (2) May 27: Evacuation of Goma



Direction: — Exits from Goma — Entries into Goma

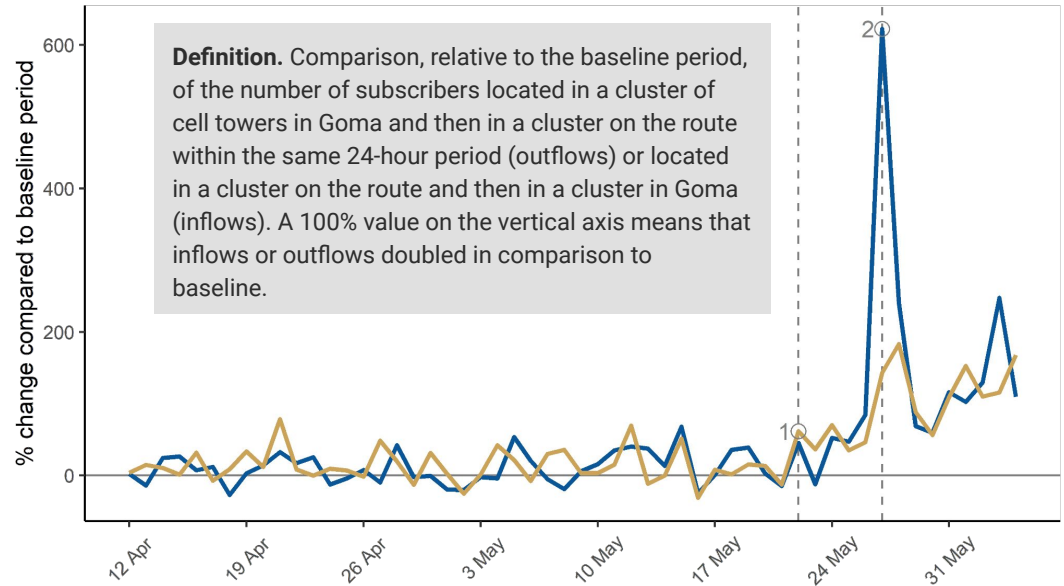
Data sources: Vodacom RDC

Goma - Masisi route

Reading the graph: The horizontal axis represents time whilst the vertical one represents percent change compared to baseline. The blue line shows outflows from Goma towards Sake, and the gold line inflows into Goma from Sake. A 100% value on the vertical axis means that inflows or outflows doubled in comparison to baseline.

Interpretation. Outflows from Goma and Sake towards Masisi increase on the day evacuation was ordered (more than 7 times more than usual). After that, both in and outflows on the same route remain much higher than normal.

Key dates: (1) May 22: Eruption of Mount Nyiragongo; (2) May 27: Evacuation of Goma



Direction: — Exits from Goma — Entries into Goma

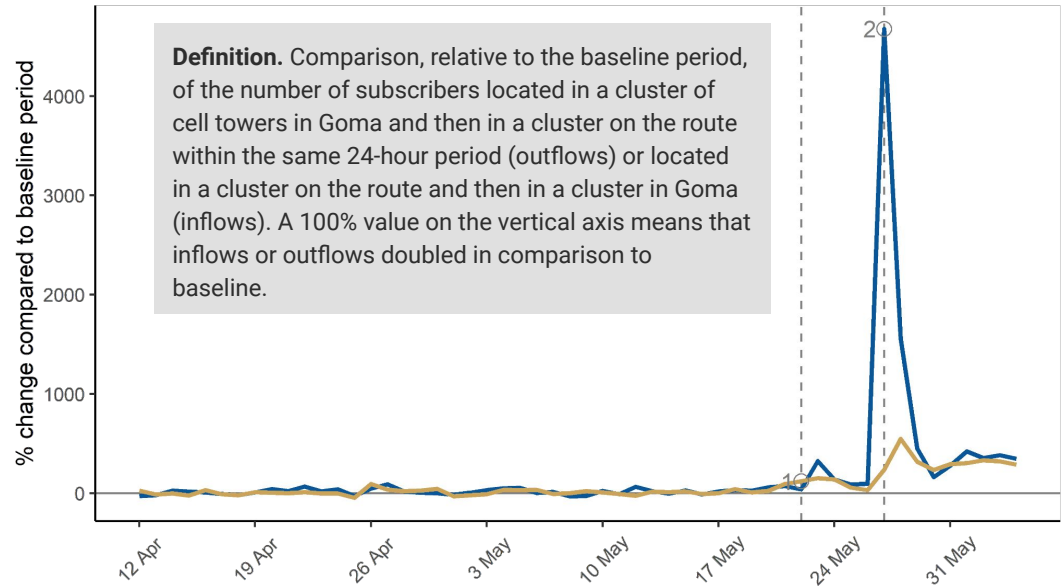
Data sources: Vodacom RDC

Goma - Rutshuru route

Reading the graph: The horizontal axis represents time whilst the vertical one represents percent change compared to baseline. The blue line shows outflows from Goma towards Sake, and the gold line inflows into Goma from Sake. A 100% value on the vertical axis means that inflows or outflows doubled in comparison to baseline.

Interpretation. Outflows from Goma towards Rutshuru mostly remain within normal range until the evacuation order, at which point a massive increase can be observed (up to 45 times more than usual). Both in and outflows remain higher than normal in the following days.

Key dates: (1) May 22: Eruption of Mount Nyiragongo; (2) May 27: Evacuation of Goma



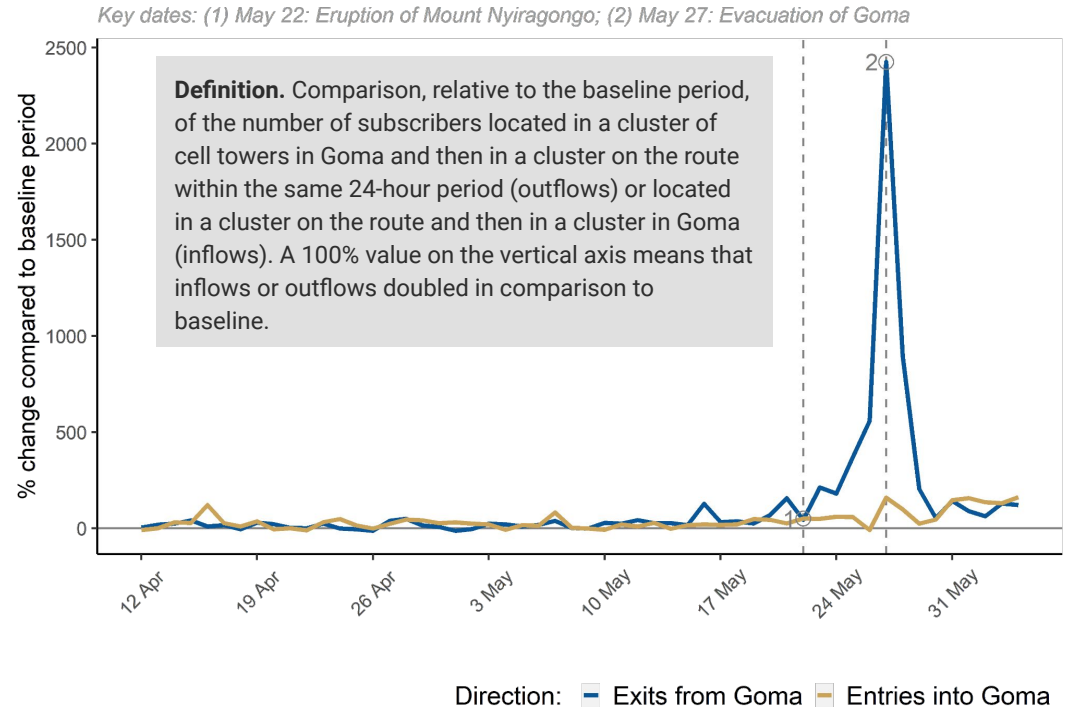
Direction: ■ Exits from Goma ■ Entries into Goma

Data sources: Vodacom RDC

Goma - Bukavu route

Reading the graph: The horizontal axis represents time whilst the vertical one represents percent change compared to baseline. The blue line shows outflows from Goma towards Sake, and the gold line inflows into Goma from Sake. A 100% value on the vertical axis means that inflows or outflows doubled in comparison to baseline.

Interpretation. Outflows from Goma towards Bukavu increase steadily from the day following the eruption, and reach a peak on evacuation day at 23 times more than usual. Inflows back into Goma are slightly higher than usual.



Data sources: Vodacom RDC

An aerial photograph of a densely populated city, likely Goma, with a large volcano in the background under a cloudy sky. The image is overlaid with a blue gradient.

Flows of subscribers on the main travel routes caused by the eruption

In this section, we map the flows and their magnitude over the Goma-Bukavu, Goma-Sake-Masisi and Goma-Rutshuru routes.

Baseline flows of subscribers

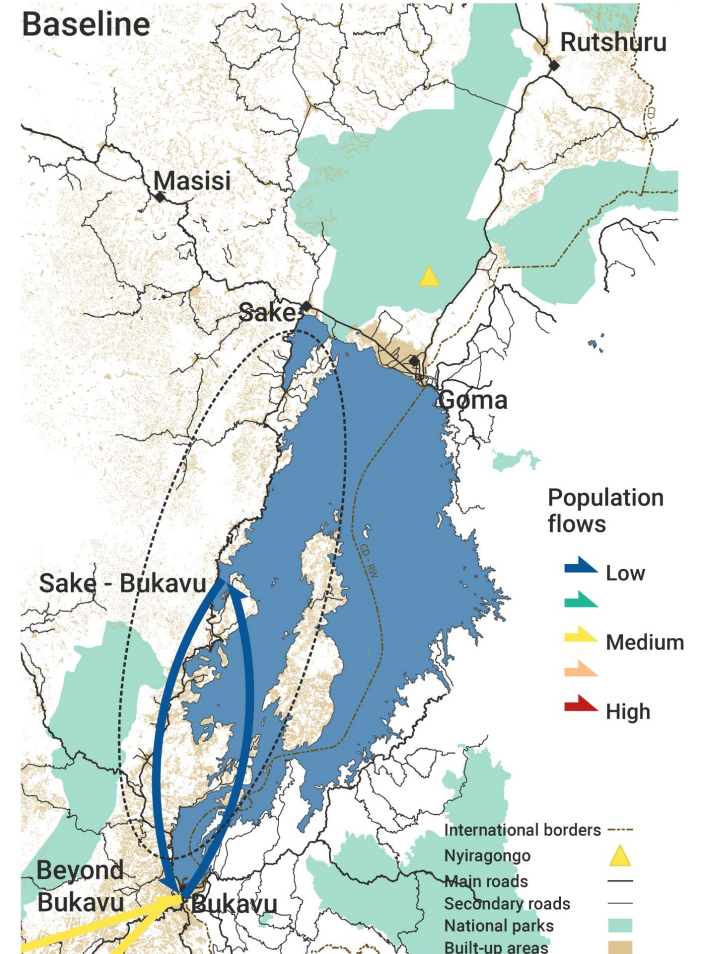
Definition

Number of subscribers located in a group of clusters (origin) and then in another (destination) during the same 24h period.

The flows shown are included in the highest 10% in terms of magnitude over the analysis period (193 origin-destination pairs). This selection represents about 80% of the total magnitude of flows measured in the focus zone during the analysis period.

Reading the map. Only the flows within the highest 10% of the analysis period are shown. Arrows represent flows from and into towns and groups on main routes (dotted lines represent the groupings). Colours indicate the magnitude of the flows. The redder the arrow, the higher the flow.

Interpretation. At baseline, only flows departing and arriving in Bukavu are high enough to appear on the map: both in and outflows with the area between Sake and Bukavu, and both in and outflows with the area beyond Bukavu towards Mwenga, Bunyakiri et Uvira.



Flows of subscribers - May 22

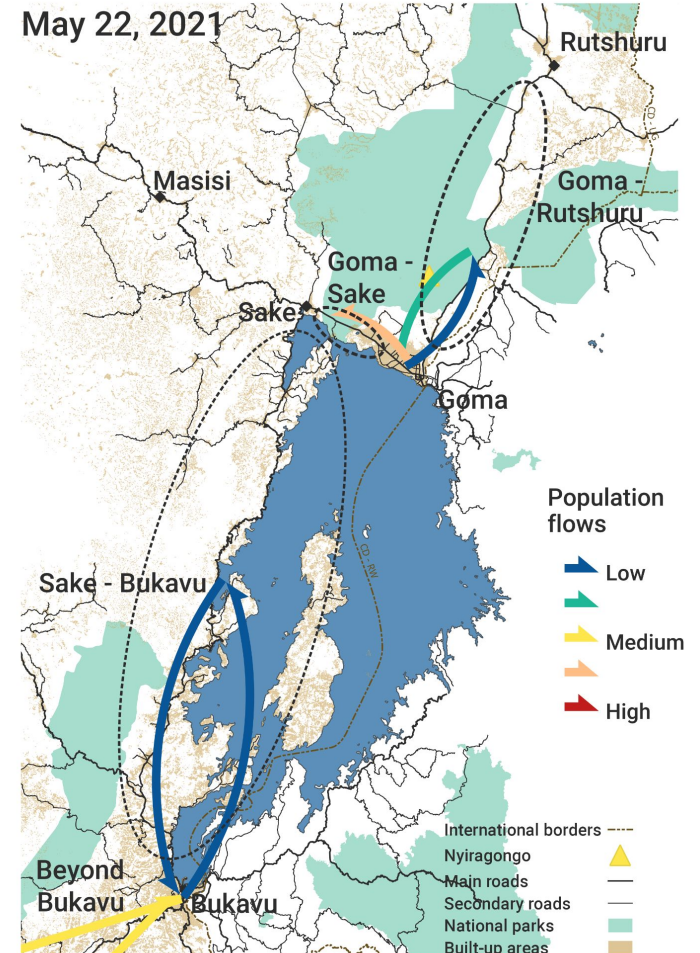
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Reading the map. Only the flows within the highest 10% of the analysis period are shown. Arrows represent flows from and into towns and groups on main routes (dotted lines represent the groupings). Colours indicate the magnitude of the flows. The redder the arrow, the higher the flow.

Interpretation. On the day of the eruption, flows from Goma to the area between Goma and Sake increase largely and appearing on the map. Flows to and from Goma towards Rutshuru can only be observed.



Flows of subscribers - May 23

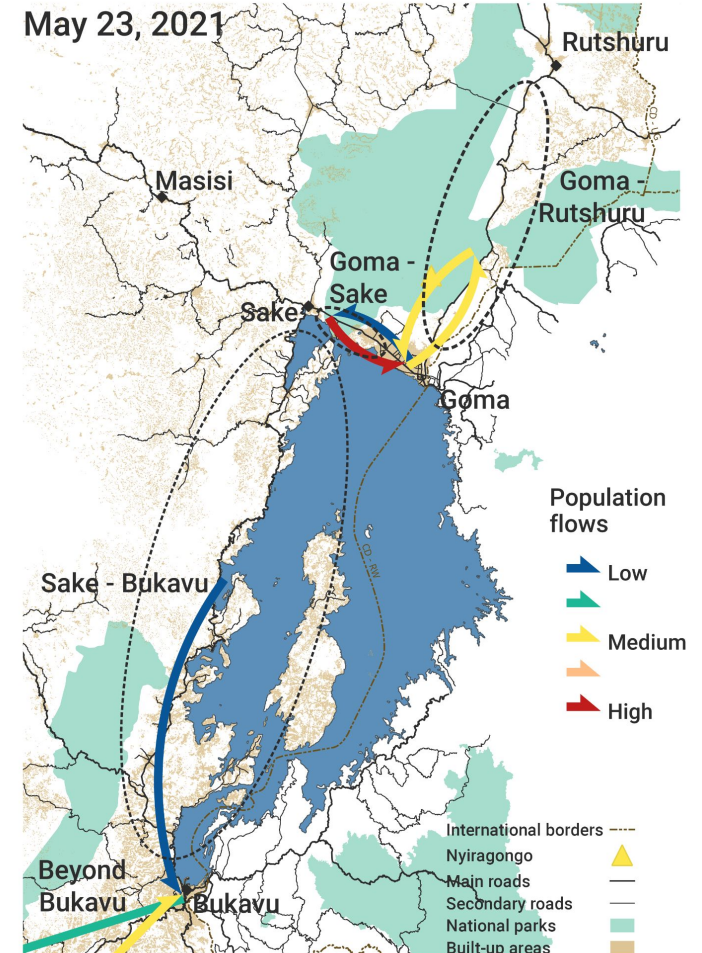
Definition

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Reading the map. Only the flows within the highest 10% of the analysis period are shown. Arrows represent flows from and into towns and groups on main routes (dotted lines represent the groupings). Colours indicate the magnitude of the flows. The redder the arrow, the higher the flow.

Interpretation. Flows from and to Goma from the north both increase. Those out of Goma in direction of Sake decrease slightly whilst those back to Goma increase noticeably. Flows between the area between Sake and Bukavu and the town of Bukavu appear on the map.



Flows of subscribers - May 24

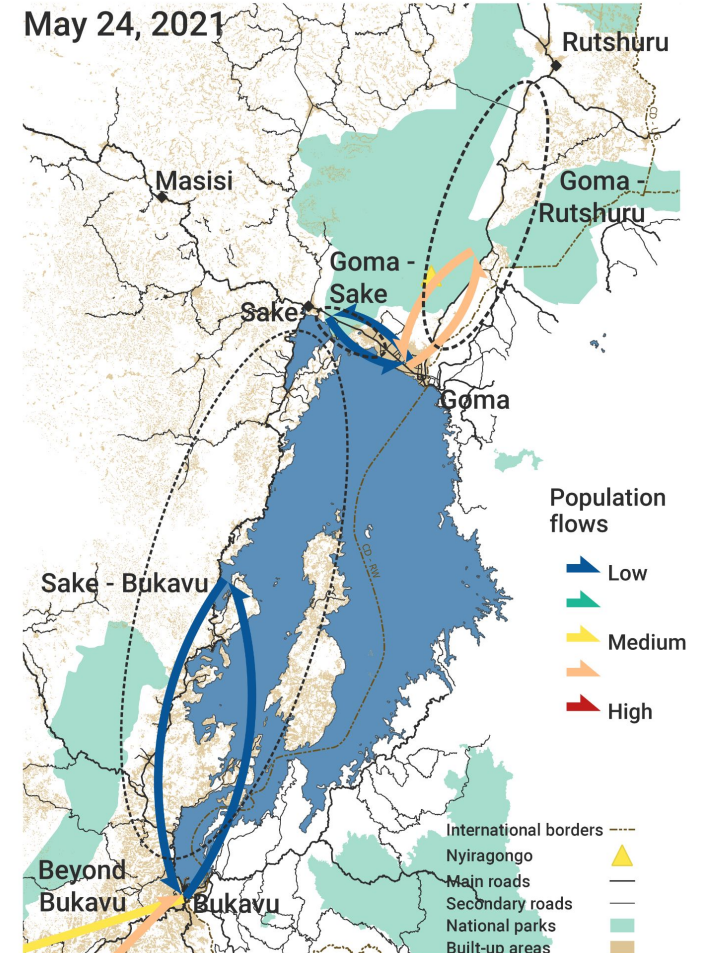
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Reading the map. Only the flows within the highest 10% of the analysis period are shown. Arrows represent flows from and into towns and groups on main routes (dotted lines represent the groupings). Colours indicate the magnitude of the flows. The redder the arrow, the higher the flow.

Interpretation. Flows west and north to and from Goma continue. The same is observed for flows between the town of Bukavu and the area between Sake and Bukavu.



Flows of subscribers - May 25

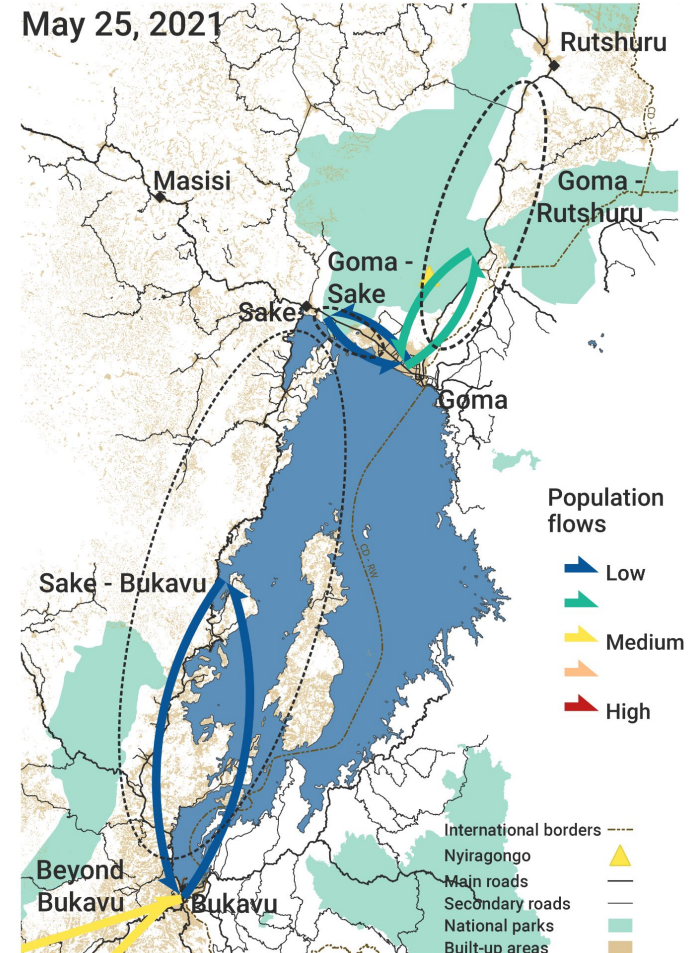
Definition

Number of subscribers located in a group of clusters (origin) and then in another (destination) during the same 24h period.

The flows shown are included in the highest 10% in terms of magnitude over the analysis period (193 origin-destination pairs). This selection represents about 80% of the total magnitude of flows measured in the focus zone during the analysis period.

Reading the map. Only the flows within the highest 10% of the analysis period are shown. Arrows represent flows from and into towns and groups on main routes (dotted lines represent the groupings). Colours indicate the magnitude of the flows. The redder the arrow, the higher the flow.

Interpretation. Trends similar to the previous days can be observed. Flows west and north to and from Goma continue. The same is observed for flows between the town of Bukavu and the area between Sake and Bukavu.



Flows of subscribers - May 26

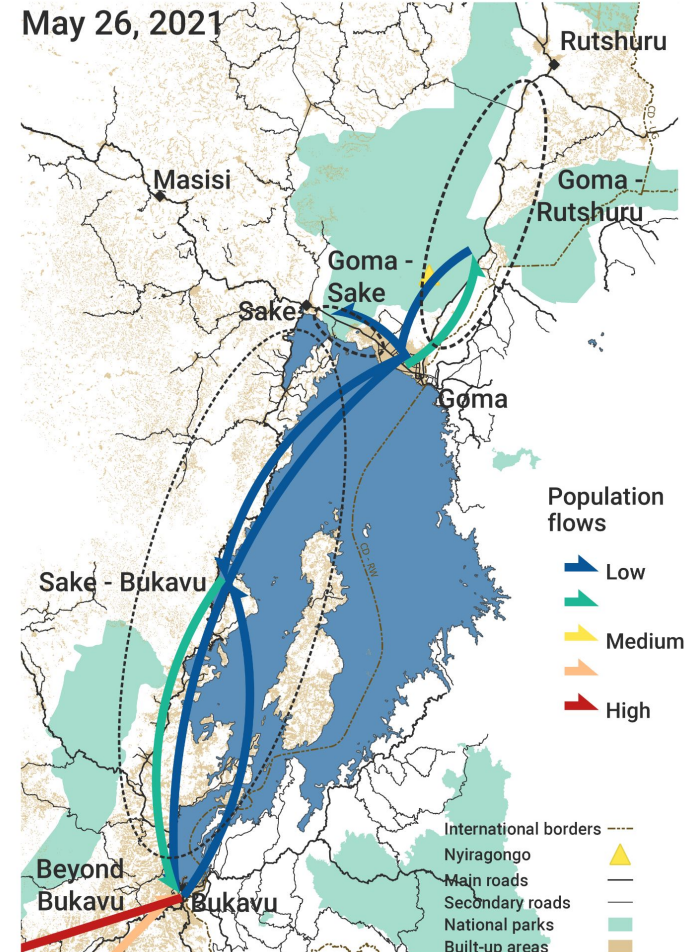
Definition

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The flows shown are included in the highest 10% in terms of magnitude over the analysis period (193 origin-destination pairs). This selection represents about 80% of the total magnitude of flows measured in the focus zone during the analysis period.

Reading the map. Only the flows within the highest 10% of the analysis period are shown. Arrows represent flows from and into towns and groups on main routes (dotted lines represent the groupings). Colours indicate the magnitude of the flows. The redder the arrow, the higher the flow.

Interpretation. Flows from Goma to Bukavu and to the area between Sake and Bukavu increase, whilst flows back to Goma from the west decrease. Flows in and out of Bukavu in direction of the south and the west become noticeably stronger.



Flows of subscribers - May 27*

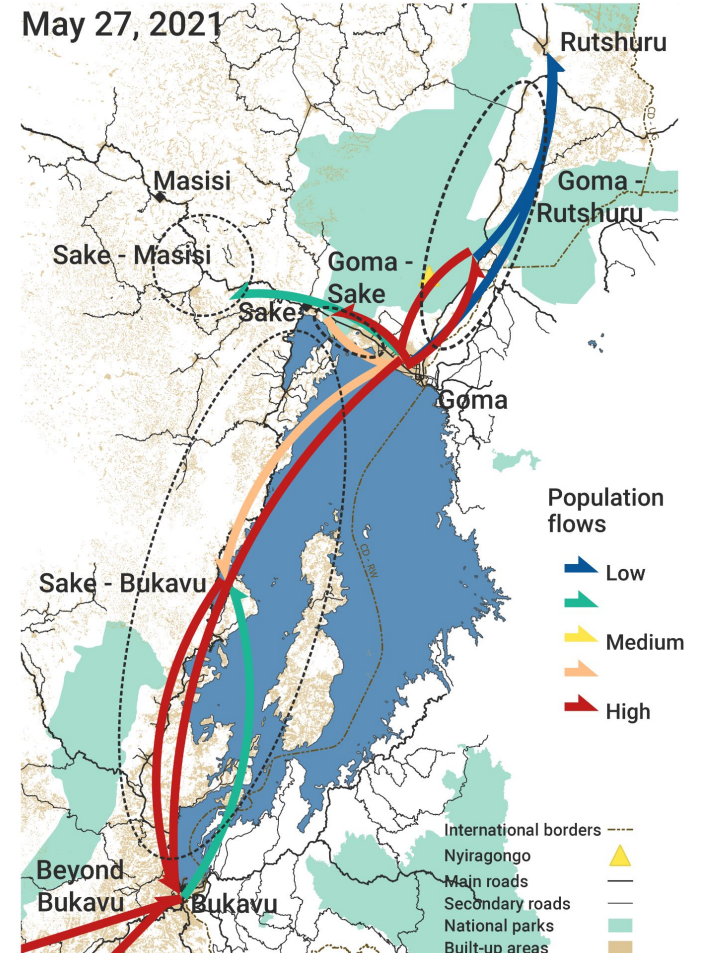
Definition

Number of subscribers located in a group of clusters (origin) and then in another (destination) during the same 24h period.

The flows shown are included in the highest 10% in terms of magnitude over the analysis period (193 origin-destination pairs). This selection represents about 80% of the total magnitude of flows measured in the focus zone during the analysis period.

Reading the map. Only the flows within the highest 10% of the analysis period are shown. Arrows represent flows from and into towns and groups on main routes (dotted lines represent the groupings). Colours indicate the magnitude of the flows. The redder the arrow, the higher the flow.

Interpretation. The day of the evacuation order, flows from Goma in all 3 directions (Rutshuru, Masisi and Bukavu) increase, and so do flows from and to Bukavu in direction of the south and west. Flows from Goma to Rutshuru appear following the reopening of the N2 beyond the damages caused by the initial lava flow. Flows into Goma from the north and the west remain intense.



Flows of subscribers - May 28

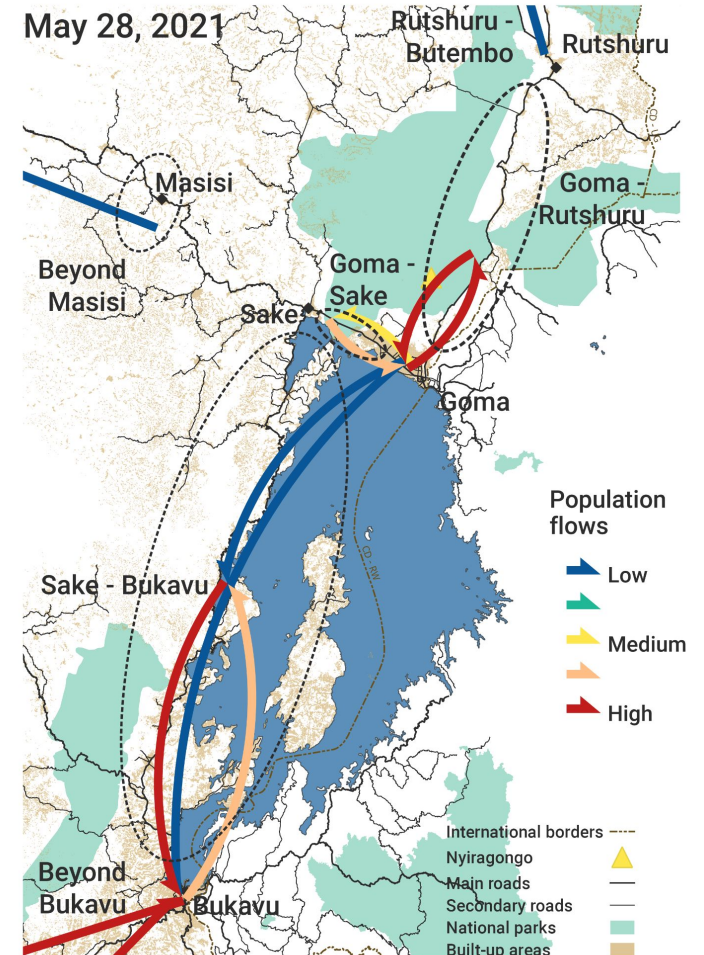
Definition

Number of subscribers located in a group of clusters (origin) and then in another (destination) during the same 24h period.

The flows shown are included in the highest 10% in terms of magnitude over the analysis period (193 origin-destination pairs). This selection represents about 80% of the total magnitude of flows measured in the focus zone during the analysis period.

Reading the map. Only the flows within the highest 10% of the analysis period are shown. Arrows represent flows from and into towns and groups on main routes (dotted lines represent the groupings). Colours indicate the magnitude of the flows. The redder the arrow, the higher the flow.

Interpretation. Flows from Goma to Sake, to the area between Sake and Bukavu and to Bukavu decrease slightly. Flows from and to Bukavu in direction of the south and west remain high. Flows from Rutshuru towards Butembo and flows from Masisi to further west appear on the map. Flows both into Goma from the north and the west continue to be high.



Flows of subscribers - May 29

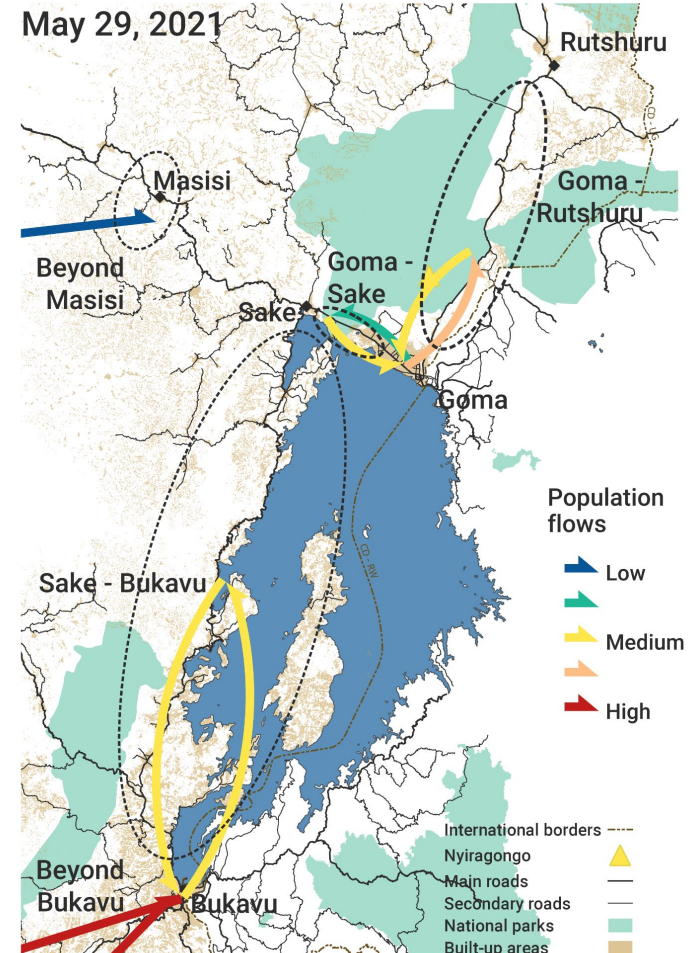
Definition

Number of subscribers located in a group of clusters (origin) and then in another (destination) during the same 24h period.

The flows shown are included in the highest 10% in terms of magnitude over the analysis period (193 origin-destination pairs). This selection represents about 80% of the total magnitude of flows measured in the focus zone during the analysis period.

Reading the map. Only the flows within the highest 10% of the analysis period are shown. Arrows represent flows from and into towns and groups on main routes (dotted lines represent the groupings). Colours indicate the magnitude of the flows. The redder the arrow, the higher the flow.

Interpretation. Flows from Goma to the area between Sake and Bukavu and to Bukavu decrease significantly. Those to and from Goma in direction of the north and west decrease too but remain apparent. Flows from and to Bukavu in direction of the south and west persist at a high level.



Flows of subscribers - May 30

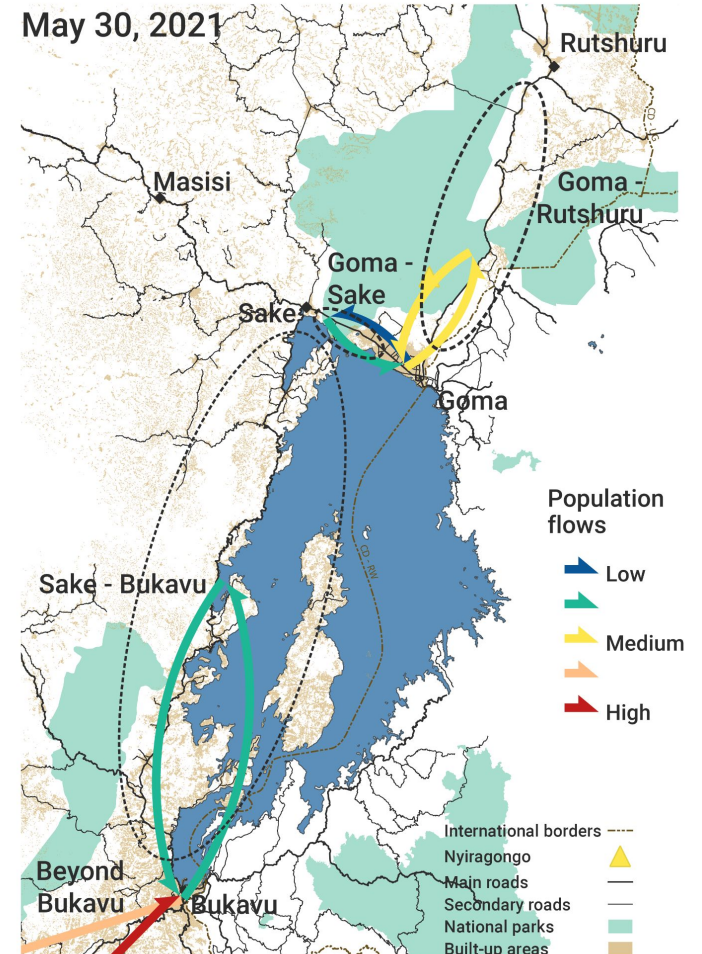
Definition

Number of subscribers located in a group of clusters (origin) and then in another (destination) during the same 24h period.

The flows shown are included in the highest 10% in terms of magnitude over the analysis period (193 origin-destination pairs). This selection represents about 80% of the total magnitude of flows measured in the focus zone during the analysis period.

Reading the map. Only the flows within the highest 10% of the analysis period are shown. Arrows represent flows from and into towns and groups on main routes (dotted lines represent the groupings). Colours indicate the magnitude of the flows. The redder the arrow, the higher the flow.

Interpretation. Only flows between Goma and areas towards Rutshuru and Sake, and those in and out of Bukavu remain apparent.



Flows of subscribers - May 31

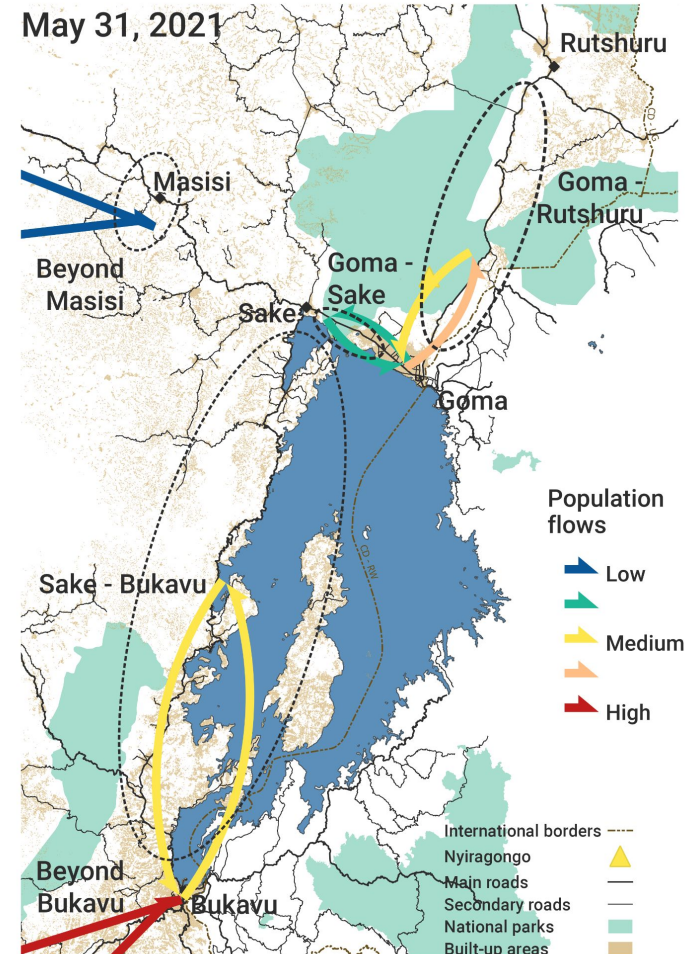
Definition

Number of subscribers located in a group of clusters (origin) and then in another (destination) during the same 24h period.

The flows shown are included in the highest 10% in terms of magnitude over the analysis period (193 origin-destination pairs). This selection represents about 80% of the total magnitude of flows measured in the focus zone during the analysis period.

Reading the map. Only the flows within the highest 10% of the analysis period are shown. Arrows represent flows from and into towns and groups on main routes (dotted lines represent the groupings). Colours indicate the magnitude of the flows. The redder the arrow, the higher the flow.

Interpretation. Similar observations to the previous day, with additional flows to and from Masisi in direction of the west.



Flows of subscribers - June 1

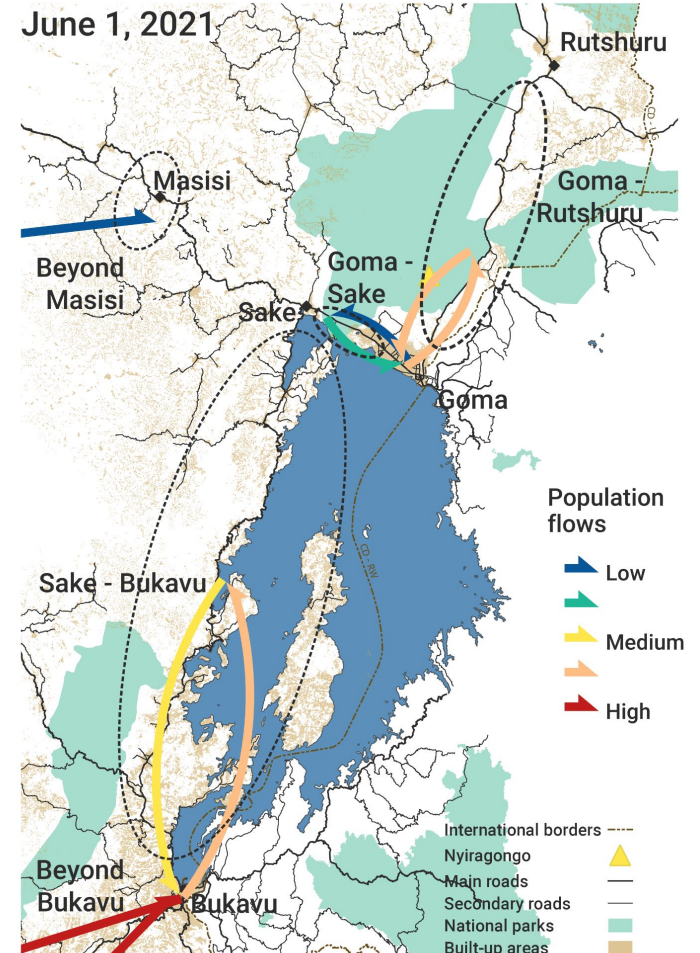
Definition

Number of subscribers located in a group of clusters (origin) and then in another (destination) during the same 24h period.

The flows shown are included in the highest 10% in terms of magnitude over the analysis period (193 origin-destination pairs). This selection represents about 80% of the total magnitude of flows measured in the focus zone during the analysis period.

Reading the map. Only the flows within the highest 10% of the analysis period are shown. Arrows represent flows from and into towns and groups on main routes (dotted lines represent the groupings). Colours indicate the magnitude of the flows. The redder the arrow, the higher the flow.

Interpretation. Similar observations to the previous day, with flows back to Masisi from the west. Flows between Goma and the area between Goma and Rutshuru persist at a high level.



Flows of subscribers - June 2

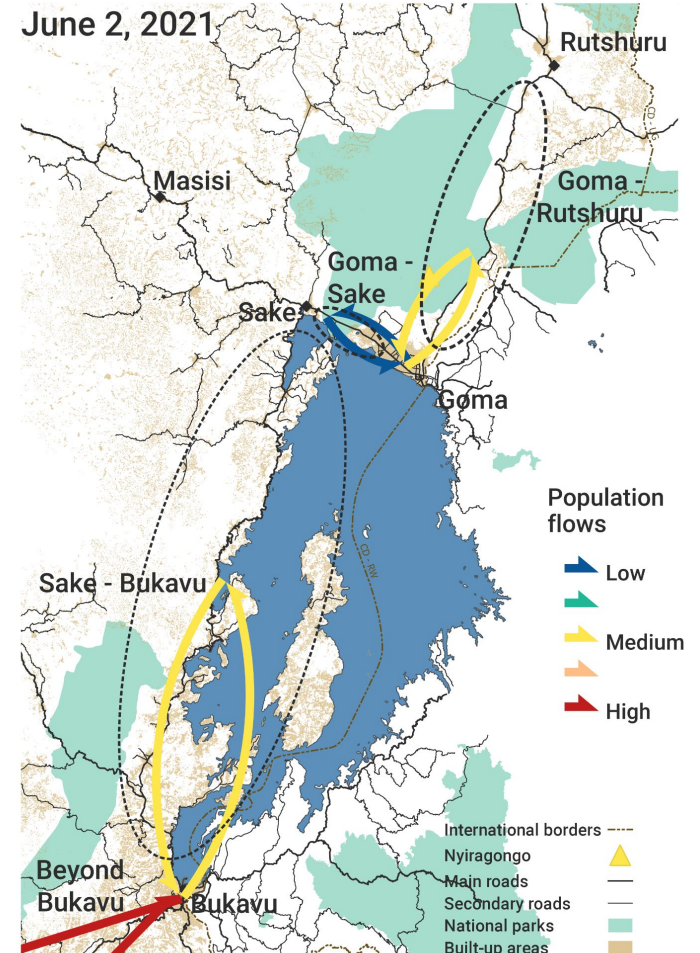
Definition

Number of subscribers located in a group of clusters (origin) and then in another (destination) during the same 24h period.

The flows shown are included in the highest 10% in terms of magnitude over the analysis period (193 origin-destination pairs). This selection represents about 80% of the total magnitude of flows measured in the focus zone during the analysis period.

Reading the map. Only the flows within the highest 10% of the analysis period are shown. Arrows represent flows from and into towns and groups on main routes (dotted lines represent the groupings). Colours indicate the magnitude of the flows. The redder the arrow, the higher the flow.

Interpretation. Similar observations since the 30th of May. Flows from and to Bukavu in direction of the south and west persist at a high level.



Flows of subscribers - June 3

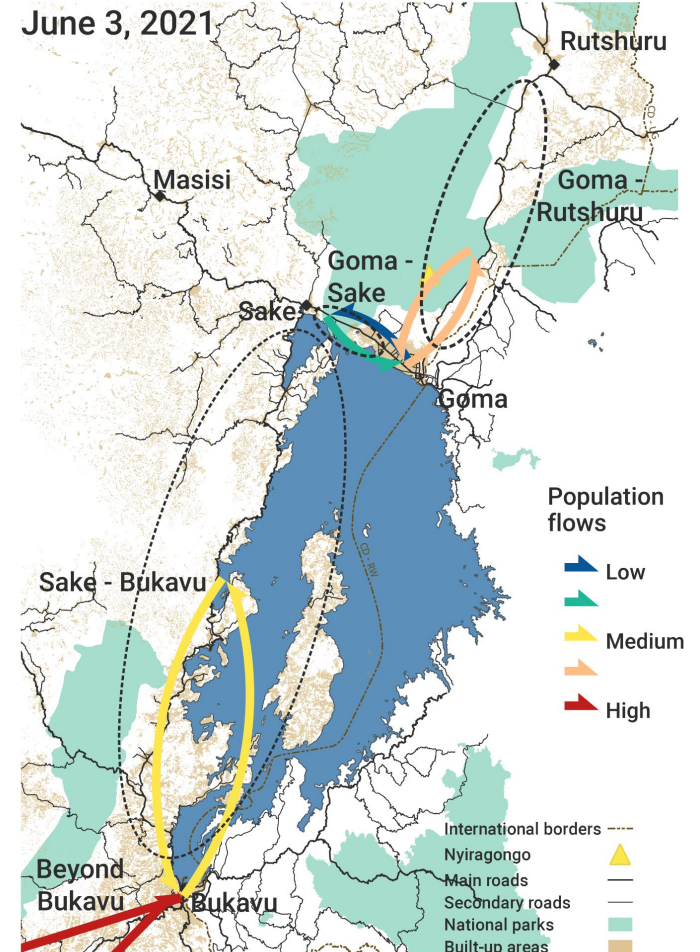
Definition

Number of subscribers located in a group of clusters (origin) and then in another (destination) during the same 24h period.

The flows shown are included in the highest 10% in terms of magnitude over the analysis period (193 origin-destination pairs). This selection represents about 80% of the total magnitude of flows measured in the focus zone during the analysis period.

Reading the map. Only the flows within the highest 10% of the analysis period are shown. Arrows represent flows from and into towns and groups on main routes (dotted lines represent the groupings). Colours indicate the magnitude of the flows. The redder the arrow, the higher the flow.

Interpretation. Similar observations since the 30th of May. Flows from and to Bukavu in direction of the south and west persist at a high level.



Flows of subscribers - June 4

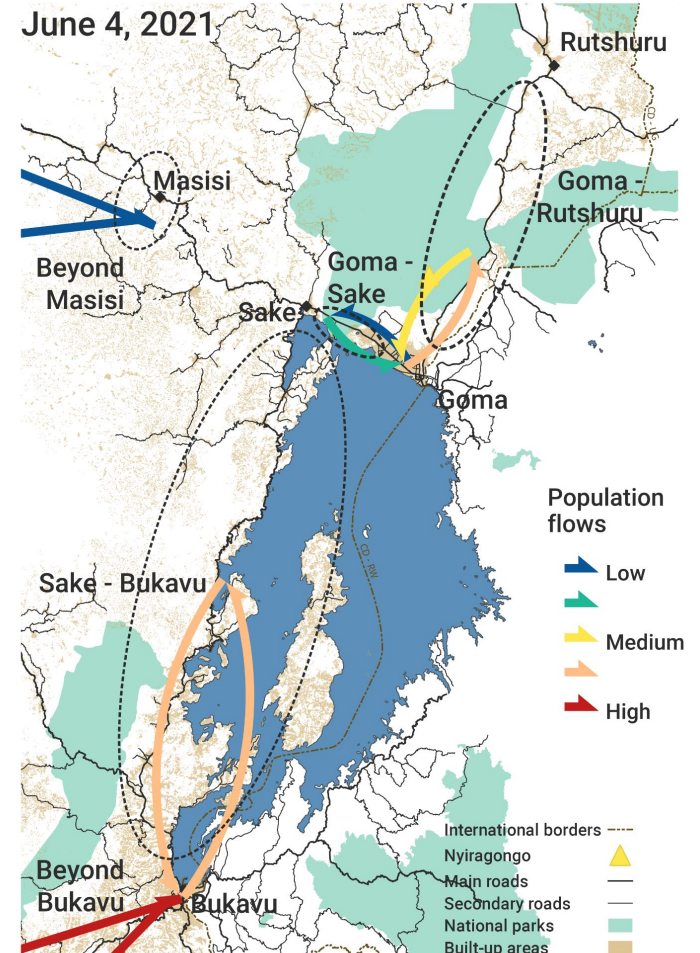
Definition

Number of subscribers located in a group of clusters (origin) and then in another (destination) during the same 24h period.

The flows shown are included in the highest 10% in terms of magnitude over the analysis period (193 origin-destination pairs). This selection represents about 80% of the total magnitude of flows measured in the focus zone during the analysis period.

Reading the map. Only the flows within the highest 10% of the analysis period are shown. Arrows represent flows from and into towns and groups on main routes (dotted lines represent the groupings). Colours indicate the magnitude of the flows. The redder the arrow, the higher the flow.

Interpretation. Similar observations since the 30th of May, with flows in and out of Masisi with the west of Masisi. Flows between Goma and the area between Goma and Rutshuru remain high, and so do those in and out of Bukavu. .





Conclusion

In this section, we summarize the analysis, implications and we propose next steps.

Executive summary

The Mount Nyiragongo erupted on May 22, 2021. Although the time for emergency response has passed, the estimated scale of population movements suggests that recovery from this disaster and a return to normal may require significant efforts over the coming weeks and months.

Mobility analyses conducted by Flowminder and Vodacom RDC can help monitor the return to normal and provide essential information to support decisions related to where allocating resources for displaced people efficiently.

The difference between estimated inflows and outflows suggests that a large number of the displaced people had not yet returned to Goma by the 4th of June (the end of the period of analysis). Departures for each of the three major travel routes (from Goma to Bukavu, to Rutshuru-Butembo, and to Sake-Masisi) truly began only on May 27, the day of the evacuation of Goma. By June 4, no mass return to Goma is observed and subscribers presence is above the baseline period in Bukavu, Rutshuru, Butembo, and Sake and Masisi. This suggests that large numbers of displaced people had not yet returned to Goma.

Vulnerability to cholera outbreaks throughout the affected areas is a major public health concern despite several vaccination campaigns in 2019 and 2020. Other infectious diseases may also spread more widely than in the past and hence require closer monitoring. Over the coming weeks and months, mobility data can play a key role in this effort.

Next steps: objectives

- Identify and produce priority information and indicators for stakeholders
- Continue to measure the movements of populations who have left or are leaving Goma, and the movements back to Goma
- Identify areas where the population has changed the most since May 23rd
- Assess the public health risks to which displaced or returned populations are most exposed

Next analysis steps

- Continuation of the analyses presented here after the 4th of June
- Compilation of more robust indicators taking into account the duplication of subscriber locations, the duration of presence at the location (residence vs visit)
- Estimation of the number of people corresponding to a subscriber and therefore of the absolute number of people moved / actually moving
- Compilation of more detailed indicators for the Goma clusters to better identify departure and return areas within the city
- Comparison of data on the incidence of certain infectious diseases (source DHIS2) and prevention actions in the health zones concerned

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