



**FLOWMINDER.ORG**

Leveraging geospatial and  
new population data sources  
for improved decision making

Flowminder - **Overview of services**



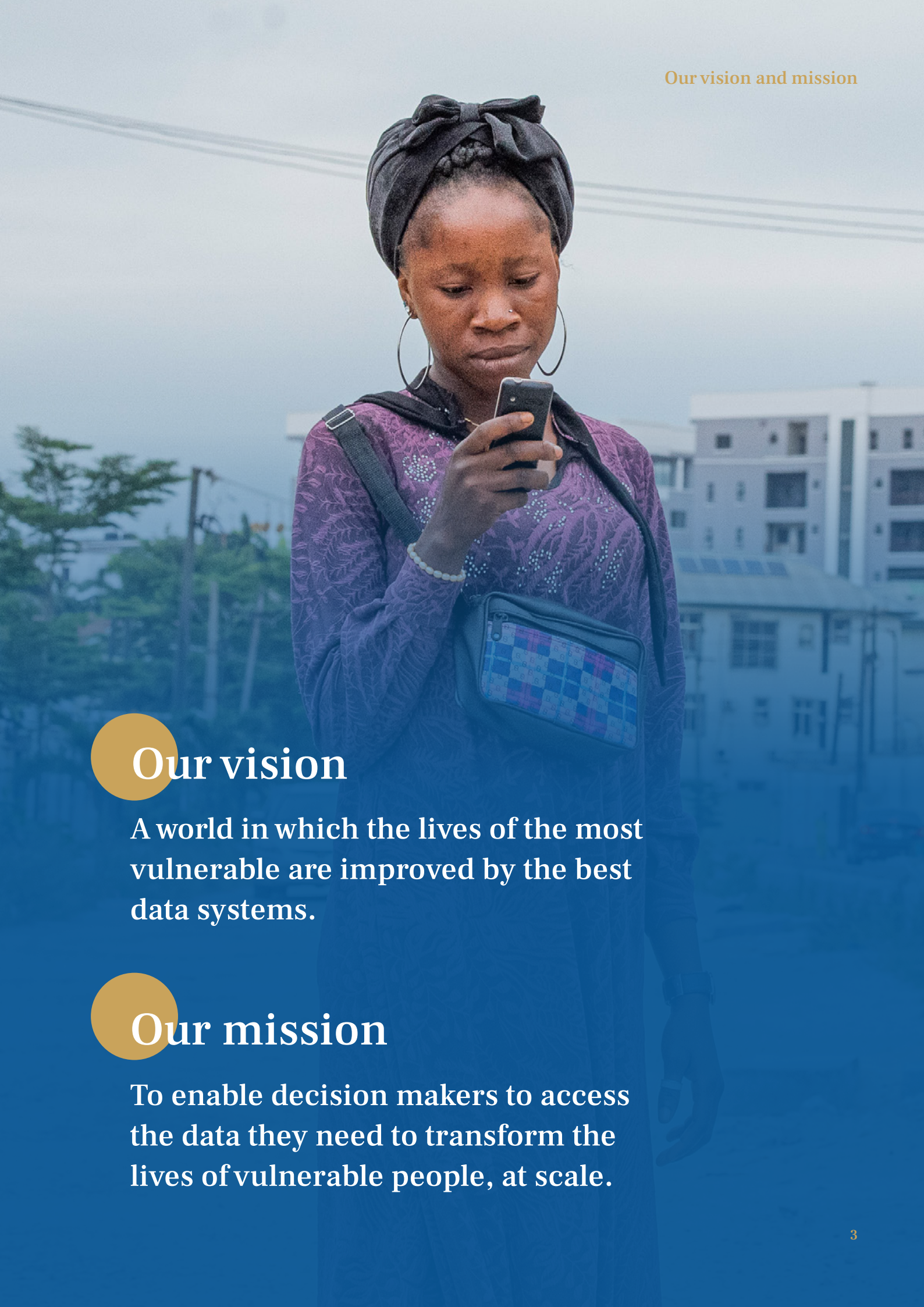
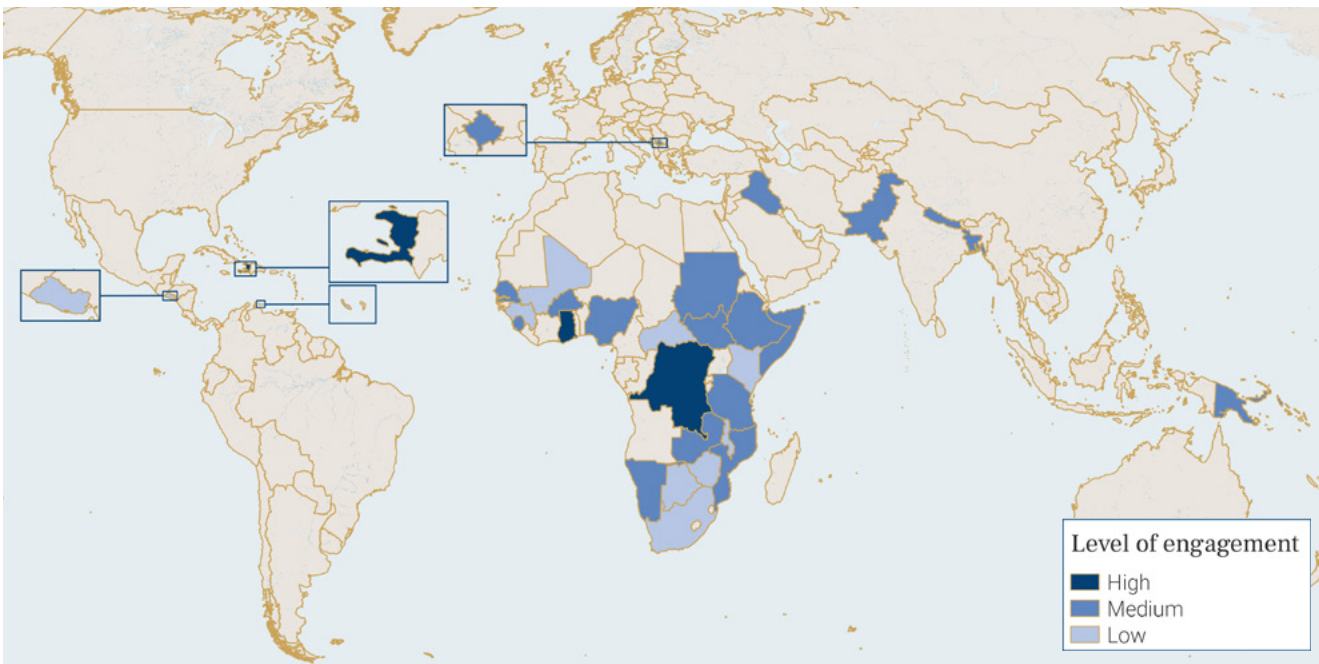
# Leveraging geospatial and new population data sources for improved decision-making

Timely and cost effective government decision-making, necessary to make progress on the Sustainable Development Goals, requires countries to be able to access and use data at high frequencies and at detailed geographic levels. This is particularly important in rapidly changing contexts and in sectors where decision-making is directly dependent on understanding distribution, displacement and migration of populations within a country.

New data sources and methods serving this purpose have become available over the past decade, enabling improved support to humanitarian and development interventions in low- and middle-income countries. In 2010, Flowminder researchers pioneered the use of mobile operator data for development and humanitarian purposes (Bengtsson et al, 2011) and have since published a number of advances in the use and integration of satellite and traditional data sources to improve our understanding of, and use of data on, population distributions, characteristics and dynamics in those countries (Pape, et al., 2019; Bosco, et al., 2019).

Through a large number of projects, we have operationalised these new methods to support public decision-making. We have especially strong experience in building mobile operator data partnerships, supporting governments and intergovernmental organisations in disaster response and crisis preparedness, and in supporting National Statistical Offices (NSOs) in integrating new and high frequency data sources into official statistics. We also work with governmental agencies to leverage geospatial data to optimise the number and location of services to maximise population access with constrained resources.

## Our geographical reach



## Our vision

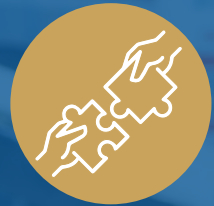
A world in which the lives of the most vulnerable are improved by the best data systems.

## Our mission

To enable decision makers to access the data they need to transform the lives of vulnerable people, at scale.



# Our approach



## Working in partnership

Development and humanitarian challenges are never simple. They often require integration of a number of perspectives, as well as skills and knowledge from several disciplines to create sustainable impact. Non-traditional data sources, such as mobile operator and satellite or geospatial data, also rely on private sector partnerships and relationships with specialised organisations. To deliver actionable and sustainable insights that are relevant to local contexts and aligned with beneficiaries' needs, we deliver our projects through partnerships, often with mobile network operators, government ministries and agencies, UN organisations and local stakeholders.



## Privacy and data governance

We provide a fully EU GDPR compliant approach to data protection. For mobile operator data, we ensure that it stays with the data controllers (e.g. mobile network operators) to be processed within their own internal secure systems. All of the mobile data outputs produced by Flowminder's code and methods are aggregated data, meaning that they do not contain individual-level information (they are grouped statistics). Any outputs that may be shared with external parties for analysis purposes therefore guarantee that the privacy of all individuals is maintained.



## Scientific excellence and innovation

We base our methods on robust academic research, much of it has been developed and published by our in-house researchers in high-impact peer-reviewed academic journals. Flowminder researchers were the first to develop, validate and operationalise the use of mobile operator data to estimate population displacement in an humanitarian emergency. They were also the first to show that mobile operator data can be used to predict post-disaster population movements based on pre-disaster mobile data (Lu et al., 2012). Similarly, we also pioneered the use of mobile operator data to respond to a large-scale infectious disease outbreak (Bengtsson et al., 2011) and show that mobile data can be used to predict the spatial spread of an infectious disease (Bengtsson et al., 2015).

A complete list of peer reviewed academic articles, reports and white papers can be found on our website at [www.flowminder.org](http://www.flowminder.org).



## Transparent analyses & open code

Carrying out analyses and using analysis software necessarily involves making choices. In many projects, it is hard for end users to evaluate the validity of end outputs, beyond the visual impact of striking graphics. Additionally, proprietary software serves to lock governments in low- and middle-income countries into expensive contractual agreements which are difficult to leave. Flowminder's software for processing and analysing mobile operator data is free and open source, and our methods are based on peer-reviewed academic research. We focus extensively on capacity strengthening to enable dissemination and sustainable use of our products and methods.

We also created FlowGeek, our open-access knowledge centre on mobile operator data analytics, to leverage the value of such datasets and help strengthen the community of big data experts, enthusiasts and learners on the processing and analysis of such data.

**“We partnered with people that were passionate and professional around their area of expertise. Flowminder knew exactly how to implement this and were open to making changes or adapting based on the Ghana use case. Having a strong partner that understood what was possible, and also was able to hold our hands through the journey, was phenomenal.”**

Angela Mensah-Poku, Ex-Director, Digital & Commercial,  
Vodafone Ghana (Source: Data for Good webinar #1, May 2023)



**Watch now**  
Webinar: Lessons learnt | Setting up  
successful public-private partnerships



# Our services

We work across the data value chain to provide timely and bespoke mobile data solutions. From data access to analyses and project implementation, our team is committed to finding the appropriate combination of products and services that works with the strengths and capacities of partners to ensure value is delivered via the whole data value chain.



## Mobile Data Partnerships: Unlocking access to mobile operator data

### Governance, negotiations and data pipeline

Individual level data, such as mobile operator data, are very sensitive. They are often impacted by regulation and require complex agreements to ensure the solutions being developed meet the necessary standards and expectations related to data privacy, business sensitivity, and national security concerns. Obtaining the authorisations to leverage mobile operator data may hence be a long and complex process requiring not only strong data engineering skills backed by in-depth understanding of telecom database infrastructure, but also strong legal competence and a good understanding of mobile operators and government regulatory processes.

**We have a track record in multiple countries or settings to bring countries from zero to big data in use, opening up access to privately-held data and establishing mobile data partnerships, for humanitarian and development purposes.** This track record is a stepping stone in building trust when approaching new mobile operators or government bodies. Additionally, given the variety of settings in which we operate, we have developed several data access and governance models, from operators doing all the preprocessing of personal data, implying minimal legal requirements, to a more comprehensive service that provides a programming interface (an API) allowing third parties to obtain aggregated data via FlowKit, our open-source software for the secure processing of mobile operator data (specifically Call Detail Records, CDR data).

### FlowKit: Facilitating secure and compliant data processing

To protect subscribers' personal data and preserve commercial confidentiality, secure and compliant processing must be guaranteed. This is why we built FlowKit. FlowKit is an open-source suite of software tools designed and developed to address several limiting factors in the use of mobile operator data for humanitarian and development purposes. FlowKit enables the secure access, processing and analysis of anonymised (pseudonymised) subscribers' mobility patterns and network usage (specifically Call Detail Records, CDRs, a type of mobile operator data automatically generated by operators for billing purposes).

Access is controlled by mobile network operators through an API (Application Programming Interface), which provides a restricted, audited and secure access to the algorithms and methods built within FlowKit. Data analysts can then interact with the aggregated data generated by FlowKit to carry out their analyses. By providing a trusted, secure software for data access, FlowKit simplifies the challenge of facilitating compliant processing of this sensitive data.



# Improving countries’ understanding of human mobility, migration and distribution, both in everyday situations and in times of crises

To provide decision makers with **precise and accurate estimates of population changes and movements**, and thereby support interventions in sectors such as health and disaster management, we have developed **state-of-the-art methods for estimating population distribution and human mobility** using mobile phone usage data, and specifically Call Detail Records (CDRs), survey/ census and geospatial data.

Developing new methods and using different data sources, with a particular specialism in the use

of data generated by mobile network operators, we undertake analysis and provide insights that support identifying where people are, where they are going, and the routes they take to get there. These insights are targeted at decision makers and applicable to a wide range of contexts, e.g. disaster management, epidemiology and public health, urban planning, service access assessment and migration.

Flowminder’s work is backed up by years of experience and scientific research, and data is processed and analysed via FlowKit.

We can help decision makers from government ministries, departments and agencies; NGOs and INGOs; UN agencies and others to answer a wide range of questions on their populations including:

What are the patterns of movement in my area of interest? How do these change in crisis?

Are people moving more within or between regions?

How many people are moving at any particular point in time? And after a disaster? Where are people in need / displaced located?

Where are people located over time? And in particular months, days of the week or hours of the day?

Mobility restrictions (e.g. COVID-19 or Ebola lockdowns): Have people stopped moving?

Which areas are highly connected?

Our R&D team has been advancing research over the years to generate a wide range of analytical methods to assess population displacement or changes over time, identify large population movements or anomalies, or monitor mobile populations, through the production of short-term indicators (such as changes in daily/weekly presence or movements) or longer-terms indicators related to number of residents or their relocations.

These methods can be applied to analyse routine mobility or its changes during and after a disaster.

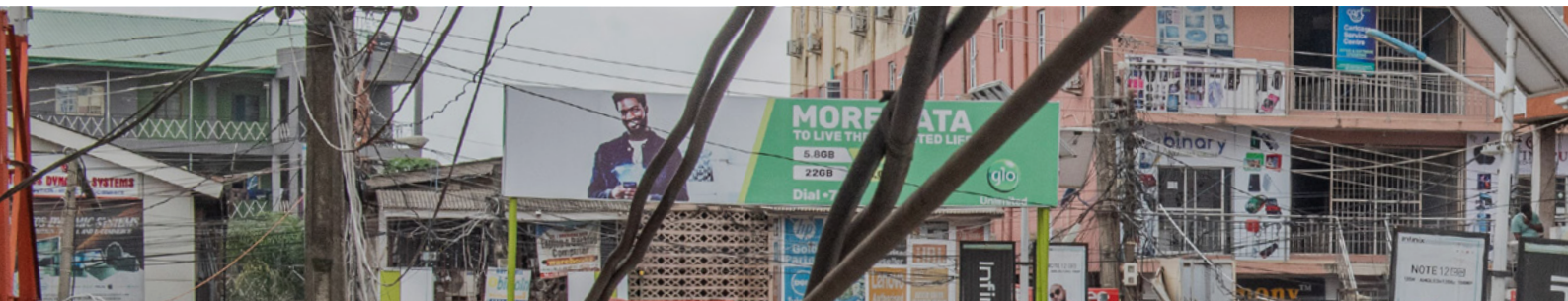
Our analyses can take the form of graphs, maps, statistics, reports or dashboards which can be used by governments, humanitarian and development practitioners or other scientists for evidence-based decision-making.

“I sincerely appreciate the thorough and well-crafted report your team provided. Its quality and relevance are truly commendable. I intend to distribute this report to our partners today.”

Fania Joseph, Executive Director at AGERCA (Alliance pour la Gestion des Risques et la Continuité des Activités), Haiti (translated from French) - In response to Flowminder’s Haiti gang violence displacement reports, August-October 2023

“[...] This analysis gives us an indication of where to prioritise our DTM field assessments and surveys to deepen our understanding of the profiles and needs of displaced people and others on the move. [...] We have therefore launched in-depth DTM assessments in this area in order to obtain more information about the displacement situation there.”

Yakin Mwanza, Data and Research Unit Coordinator at IOM-DTM, Data Management Unit (translated from French) - In response to Flowminder’s Haiti gang violence displacement reports, August-October 2023





## Optimising the number and location of services to maximise access with constrained resources

To maximise access to public and private physical services, such as schools, health facilities and financial services, they need to be located where they can reach the largest possible share of the population. Detailed data on population distributions, roads and river networks, population mobility patterns and a range of other geospatial data are available, which can help decision makers better identify service allocation issues.

**With these data, we have developed a new methodology to support decision makers in identifying the best locations for their services, and facilitate data-driven decision making.**

Our spatial optimisation solution rapidly models a set of ranked service point locations necessary to achieve 100% coverage of the population

under different constraints. The methods can be encapsulated in tools for specific application domains (e.g. health, education) and users (e.g. policy makers, data analysts). The work supports cost efficient use of resources as well as enabling transparency and accountability of resource allocation decisions e.g. in the health, education and financial services sectors.



**“Without Flowminder’s pilot data - these two missed communities would not have been served.”**

Mohamed Dhiif, HMIS Officer at READO, Somalia.

As part of an innovative pilot approach to validate data and gather user feedback, READO used our microplanning support documents (integrating our optimisation outputs) to identify and reach communities in crisis and ultimately expand childhood immunisation coverage in Southwest Somalia.



**Read more**  
**Case study:** Reaching communities in crisis: expanding immunisation coverage in Southwest Somalia

## Data applications: Turning data into actionable solutions

Turning data into applications for sustainable development is a key priority to achieve our mission. This is why we recognise the importance of collaboration in developing successful, innovative and impactful data projects.

We aim for our data to be made open source, and our analyses to be shared. We also ensure we work

closely with decision makers to interpret our data, incorporating local knowledge and additional data sources to provide governments or in-country actors with a wide range of actionable insights, linked to the local context. On page 12, we provide examples of projects and applications where our services are combined to provide impact tailored to the needs of end users.

## Capacity strengthening in the use of mobility and geospatial data for decision making

We strengthen the capacity of governments, UN agencies, mobile operators, private companies and NGOs to make the most of novel data types.

From geospatial to mobile operator data analytics, we work with in-country partners to create sustainable and long-lasting solutions.

Our team can provide a wide range of capacity strengthening and support activities, from technical assistance and training to the creation of tools and products designed to enable end users to make effective use of data for decision making.



# Examples of projects and integration of services

## Integrating mobile operator data into official statistics in Ghana

We work with Ghana Statistical Services (GSS) and Telecel Ghana (ex Vodafone Ghana) to produce official statistics using de-identified mobile operator data, to strengthen humanitarian and development decision-making in the country. This collaboration, which is the first of its kind in Ghana, and one of the first in Africa, is aimed at taking advantage of technology to transform the production of official statistics and support the attainment of the Sustainable Development Goals in Ghana.

As part of this Data for Good partnership, we are empowering GSS with new approaches to analysing and harnessing data as well as responding to emerging opportunities and challenges. We provide services along the full length of the data value chain of mobile operator data, from the data access solution to supporting decision-making to capacity strengthening activities (for example, Python training, or training on our mobile operator data processing and analytical methods). We work in line with the operator's global privacy principles, GSMA data protection guidelines and the Ghanaian data protection regulations.

Under this Data for Good partnership, we are also supporting other ministries, departments or agencies to integrate population mobility and distribution data into their work. For example, we are supporting Ghana Health Services in improving public health metrics with the use of mobility data. We are also working with NADMO to improve their predictive capability of populations at risk of disasters, through the production of dynamic hazard risk maps.



### Watch now

**Video:** Ghana | Unique partnership provides mobility data for good to enhance development planning



## Strengthening the effectiveness and equity of vaccination interventions in the Democratic Republic of the Congo (DRC)

In October 2018, the Government of the Democratic Republic of the Congo (DRC) launched an ambitious plan to tackle low routine immunisation coverage across the country, where, in 2017, 20% of children did not receive any vaccines and two-third of all children (2.5 million) were not fully vaccinated.

Flowminder, as part of the GRID3 Mapping for Health programme, led on the delivery of mobile operator data analytics, analysis of gender obstacles to vaccination, and the implementation of a microcensus household survey to serve as

input data for the modelling of high-resolution gridded population estimates, to strengthen routine immunisation in the country. This microcensus exercise, conducted in March-April 2021 was one of the country's most extensive surveys of demographic information since the 1984 national census. It served as input data for producing national population estimates for seven provinces in eastern Democratic Republic of the Congo (DRC): Haut-Katanga, Haut-Lomami, Ituri, Kasai, Kasai-Oriental, Lomami, and Sud-Kivu.

Flowminder also oversaw capacity strengthening activities, thus ensuring all data products can be optimally used by the key health actors. With micro-planning having been identified as a key tool in ensuring the equity and effectiveness of vaccination interventions, We also developed algorithms to allow for the optimisation of the placement of advanced vaccination sessions. All products of the project were tailored through consultations with the national stakeholders to ensure the project delivers the maximum level of impact.

Finally, as the project coordinator, Flowminder was also responsible for monitoring and evaluation of the programme to ensure change was identified and documented.

We have been active in DRC since 2018 and are a technical partner of the DRC's Expanded Programme on Immunisation (EPI). We are continuing to support the EPI, for example under the Equity Accelerator Fund (EAF) programme, which aims to reduce the number of zero-dose children in the DRC – children who have received none of the essential vaccines – by 35% by 2025, with a focus on 11 provinces.



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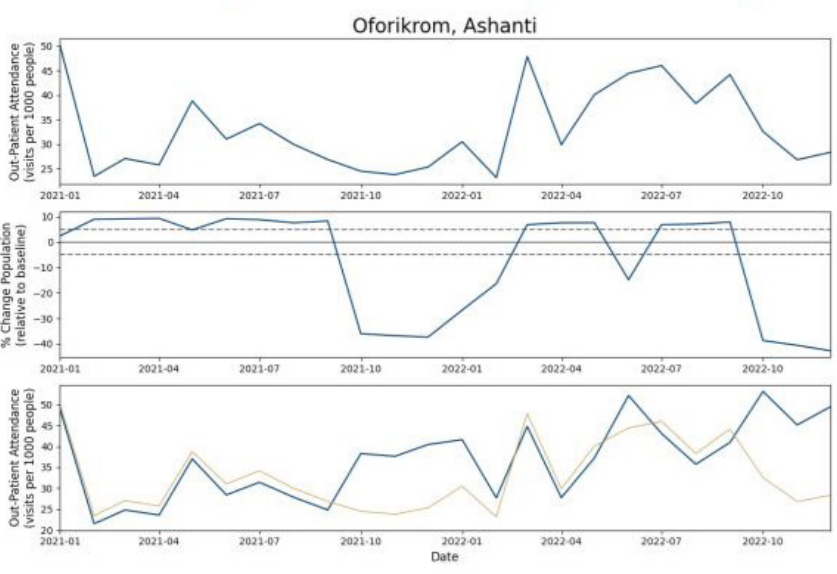
# Improving key health metrics in Ghana with the use of mobility data

Population mobility causes challenges for public health services, as the number of people in an area changes over time. Mobility is not only a factor in the spread of communicable diseases, but it also affects service demands and needs. Not knowing how many people there are in a specific area makes it difficult for health planners to calculate statistics or health metrics, such as disease infection rates, or to monitor their performance. For example, if they rely on static population values, usually taken from the latest census (which can be outdated), it's hard to tell if a sudden increase in the number of people having contracted a disease or accessing health services indicates a real change in people's health or is simply the result of more people having moved out of, or into, the area.

To address this challenge, we are working with Ghana Health Service to integrate population mobility data into their planning and interventions. As part of the Data for Good partnership with Ghana Statistical Service (GSS) and Telecel Ghana (previously Vodafone Ghana), we estimate the number of people visiting or residing in an area in near-real time, using Telecel Ghana's anonymised mobile operator data, to provide "dynamic denominators" which can be used for calculating key health metrics.

We aim for these mobile phone-derived estimates of population movement, density, and distribution to be incorporated into Ghana Health Service's health metrics, to test whether the resulting accuracy improvement can lead to more effective and efficient disease surveillance and health service delivery. In addition, we are supporting GSS to produce these innovative datasets on an ongoing basis.

## Preliminary results: Out-patient department attendance



Out-patient department (OPD) attendance 2021-2022, calculated using a static population estimate

% change in the population, based on CDR data 2021-2022

OPD attendance 2021-2022 using CDR-derived dynamic population estimate (blue), compared to a static population estimate (gold)

### Preliminary results: Out-patient department attendance in Oforikrom, Ashanti, Ghana

The top graph shows out-patient department attendance from 2021-2022, calculated using static population estimates. The second graphs represent the percentage change in the population (dynamic population estimates), based on mobile operator data, for the same period. The last graph compares the out-patient department attendance using dynamic population estimates (blue) compared to static estimates (gold).



# Mobility in crisis: Population displacement triggered by gang violence in Haiti

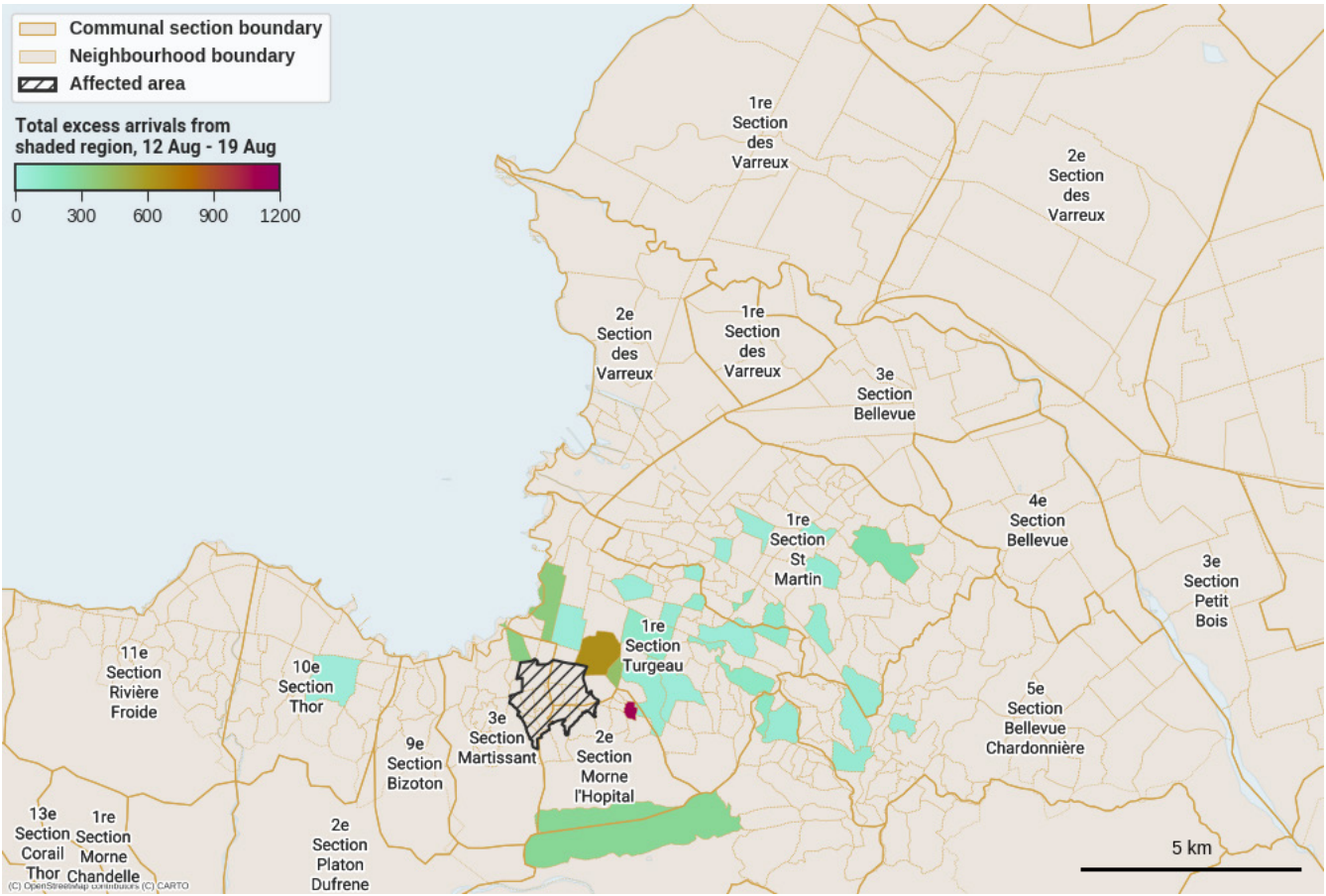
Haiti is highly susceptible to disasters, such as earthquakes, hurricanes, and tropical storms, with the 2010 earthquake having had a devastating and long-term impact on the country. Additionally, the escalation of gang violence in the country, following the assassination of the President Jovenel Moïse in July 2021, has exacerbated the situation, triggering sudden and unusual population movements and changes to internal migration across the country. With an estimated 11.5 million inhabitants in 2023, and no recent official population data (the last census was conducted in 2003), understanding where people live, how they move, and where they move to routinely, and when a crisis hits, is therefore paramount for effective humanitarian aid and development interventions.

Our collaboration with Digicel Haiti first started following the 2010 Haiti earthquake, and has since gone from strength to strength. By securely and innovatively analysing Digicel Haiti’s anonymised (pseudonymised) mobile operator data, we have been able to provide humanitarian and development actors with up-to-date dynamic perspectives on people’s movements within the country, routinely or in crisis, while preserving subscribers’ privacy, for various

crises, including earthquake, cholera outbreak, floods and more.

Between August - October 2023, to support the humanitarian response to the gang violence crisis response, we made available easy-to-use, timely and informative insights on population displacements following heightened episodes of gang violence. On request from the major humanitarian organisations, we rapidly produced concise two-page reports (in English and French) on population movements in the affected areas, in clear visual format with maps and tables, with key observations highlighted, using enhanced data analysis methods. These reports filled a data gap by rapidly providing quantitative estimations of population movements, and contributed additional insight by highlighting movements that may not be visible to on-the-ground observers and by capturing population destinations that may be outside of recognised IDP sites. The successful delivery of this solution comes from our improved approach of prioritising concise and visual reports, backed up by improved data.

Discover some of the quotes from users on pp8-9.



Neighbourhoods of Haiti where displaced subscribers have moved to, from the affected area

The coloured regions correspond to the number of displaced subscribers from the shaded area affected by violence.



# Supporting governments on COVID-19 response

To support the global response against COVID-19 and enable the generation of rapid mobility analyses, Flowminder worked with mobile network operators and governments to improve access to anonymous mobility data for improved decision making.

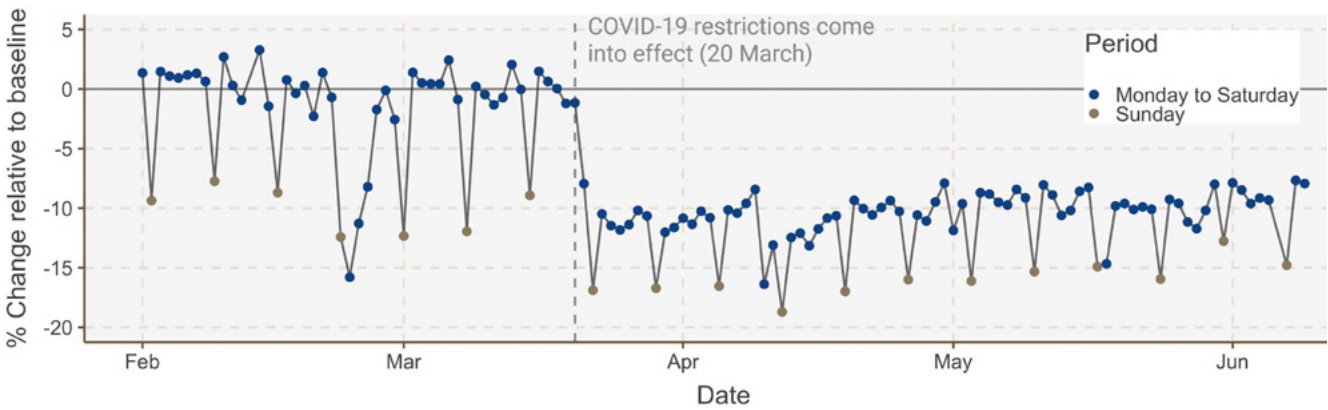
To achieve this, Flowminder released freely available and open source instructions, code and materials for operators, analysts, epidemiologists and governments to support their plans and interventions against the virus, while providing remote support to facilitate their work.

We designed a series of aggregates and indicators to represent all dimensions of mobility and published online resources that explain the key stages in the analysis of CDR data, and information that sets a standard for the CDR aggregates to be produced, and

the mobility indicators that can be derived from the aggregates, to support decision makers within the ongoing COVID-19 pandemic.

In addition, we marshalled our resources to provide in-depth hands-on analytical, technical and logistical support to a number of countries where we had access to data. We produced and released mobile operator data-derived insights on population distribution and mobility changes caused by the pandemic and the associated mobility restrictions in seven countries (Curaçao, the Democratic Republic of the Congo (DRC), Ghana, Haiti, Namibia, Papua New Guinea, and Sierra Leone). The data were used by Presidential Task Forces and Statistical Offices to support decision making by governments and health actors.

Changes in the average number of clusters visited per subscriber per day



## Example of CDR-derived insight: time variations in population mobility

This graph presents the reduction in population mobility in Haiti that immediately followed the restrictions put in place to combat the COVID-19 pandemic. It shows the change in the average number of localities visited per active phone user in the country for each day, compared to a baseline period preceding the restrictions. Drops in mobility are observed on Sundays compared to weekdays in baseline, and following restrictions the mobility on weekdays dropped to the level of a normal Sunday. The same analysis is replicated for each region and for each district, providing insights for different areas of the country, and over time. Source: Flowminder and Digicel Haiti, 2020.

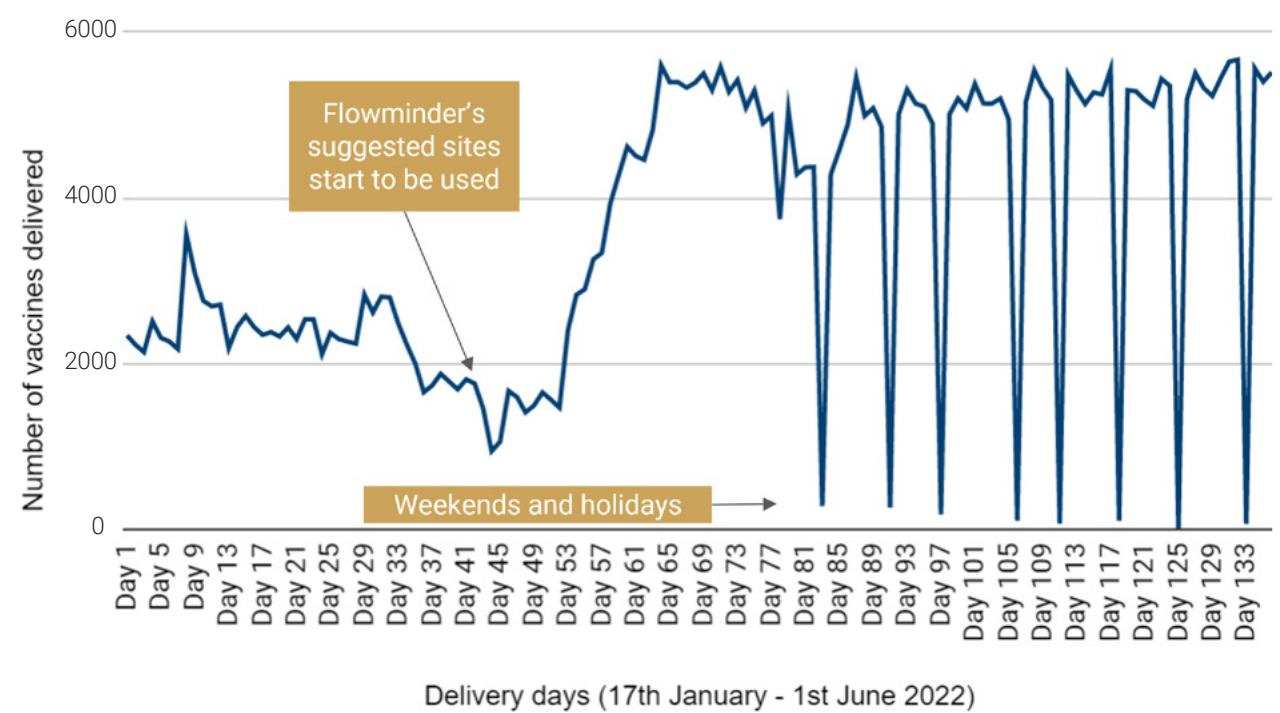




# Optimising the government of Nigeria’s COVID-19 vaccine delivery efforts

We worked with Nigeria’s Federal Ministry of Health to determine where new vaccination sites should be added to maximise population coverage. We produced optimisation outputs for the 36 states and the federal capital territory in Nigeria to identify potential locations for administering vaccines, ranked in order of three priorities.

The results were used by state health actors to plan their COVID-19 vaccination rollout. In Adamawa state, daily delivery rates increased from ~2,000 to ~5,000 once planners and vaccination teams had access to our results.



Watch now

Video: Success Story | How Nigeria increased its vaccination coverage with spatial optimisation

“The Flowminder results helped in many ways. In fact, it was a game changer for optimising our vaccination team effort and improving vaccination coverage, rapidly.”

Dr Hadley Ikwe, Senior Immunisation Specialist US Centre for Disease Control & Prevention (Nigeria)





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# About Flowminder

Flowminder is a Swedish non-profit foundation with two branch offices, in the UK and Switzerland respectively.

**Our mission is to enable decision makers to access the data they need to transform the lives of vulnerable people, at scale.** We are striving to create a world in which decisions that can improve the lives of vulnerable people are based on the most appropriate evidence.

We partner with decision makers and key stakeholders in national and international data systems to produce high-quality data, strengthen capacity, develop new methods and tools, and leverage novel data sources to improve the lives of vulnerable populations in low- and middle-income countries.

We provide information and capacity strengthening to governments, mobile network operators, national and international agencies and researchers, and have developed sustainable partnerships with numerous mobile network operators in low- and middle-income countries. Our analysts have been working for over ten years in this field, whilst preserving the privacy of mobile network subscribers and data subjects.

Our multidisciplinary team of experts includes epidemiological researchers, data scientists, software developers, engineers, and humanitarian practitioners.

## Contact us

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