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Ghana | Routine Mobility Analysis for 2020-2022

Insights into routine long term and short
term mobility in Ghana

Beta version

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Table of contents

Summary	4
1 Long term mobility	4
A Monthly population estimates (residents)	4
B Relocations	4
Top relocations	4
Relocations to/from urban areas:	5
2 Short term mobility	5
About the report	7
Authors and contributors	7
Acknowledgements	7
About the data	7
Figures Understanding the graphs	9
1 Long term mobility	10
1.1 Monthly population estimates (residents)	10
1.1.1 Population trends in the country	10
1.1.1.1 Spatial trends	10
1.1.1.2 Monthly time series of relative change in residents	11
1.1.1.3 Population statistics table	11
1.1.2 Population trends in Greater Accra	12
1.1.2.1 Spatial trends	12
1.1.2.2 Population statistics table	12
1.1.3 Population trends in Kumasi	13
1.1.3.1 Spatial trends	13
1.1.4 Population trends in Sekondi-Takoradi	14
1.1.4.1 Spatial trends	14
1.1.5 Population trends in Tamale	15

1.2 Relocations	16
1.2.1 Largest relocations (top 30) at the national level	16
1.2.2 Relocations with Greater Accra	17
1.2.2.1 Relocations incoming to districts from Greater Accra	17
1.2.2.2 Relocations outgoing from districts to Greater Accra	18
1.2.3 Relocations with Kumasi	19
1.2.3.1 Relocations incoming to districts from Kumasi	19
1.2.3.2 Relocations outgoing from districts to Kumasi	20
1.2.4 Relocations with Sekondi-Takoradi	21
1.2.4.1 Relocations incoming to districts from Sekondi-Takoradi	21
1.2.4.2 Relocations outgoing from districts to Sekondi-Takoradi	21
1.2.5 Relocations with Tamale	22
1.2.5.1 Relocations incoming to districts from Tamale	22
1.2.5.2 Relocations outgoing from districts to Tamale	23
2 Short term mobility	24
2.1 Largest movements (top 30) at the national level	24
2.2 Daily travel size distribution	25
2.3 Daily movements with Greater Accra	26
2.3.1 Spatial trends	26
2.3.2 Daily time series of relative change in travellers with Greater Accra	27
2.3.3 Abnormal values	27
2.3.4 Daily time series of relative change in travellers with Accra Metropolitan	27
2.3.5 Abnormal values	27
2.4 Daily movements with Kumasi	28
2.4.1 Spatial trends	28
2.4.2 Daily time series of relative change in travellers for Kumasi	29
2.4.3 Abnormal values	29
2.5 Daily movements with Sekondi-Takoradi	30
2.5.1 Spatial trends	30
2.5.2 Daily time series of relative change in travellers for Sekondi-Takoradi	31
2.5.3 Abnormal values	31
2.6 Daily movements with Tamale	32
2.6.1 Spatial trends	32
2.6.2 Daily time series of relative change in travellers for Tamale	33
2.6.3 Abnormal values	33
Annex	34
Data and data privacy	34
Data considerations	34
Disclaimer	34

Summary

1 | Long term mobility

A | Monthly population estimates (residents)

Based on anonymous aggregated mobile phone data, we estimate that around 44% of districts studied in Ghana show substantial population changes due to mobility in the period 2020 to 2022.

Districts are classified as:

Increasing trend: trend > *mean trend* +0.1% for a month

Decreasing trend: trend < *mean trend* -0.1% for a month

Where *mean trend* (average trends for all districts) \approx 0.038% for a month.

This represents a change of approximately over 5% / under -2.2% of the population over three years to be categorised as increasing or decreasing respectively.

Regions with a mostly decreasing population are located on the western side of the country (Western, Western North, Bono and Savannah) while regions like Ashanti or Bono East have a majority of growing districts.

By relative (i.e. percentage) change during the period, Binduri, Adansi North, Pusiga, Pru West and Daffiama Bussie are the districts with the largest increases (receiving over 13% of their pre-2020 population during the period), while Oforikrom Municipality, Upper Denkyira West, Birim North, Kwahu South and Atiwa West have the largest proportional decreases (under -9% of their pre-2020 population during the period).

Many of the districts with the largest fluctuations in the number of residents may be explained by the presence of large universities, with inflows and outflows following academic terms. For example Ayawaso West with the University of Ghana, Oforikrom Municipality with Kwame Nkrumah University of Science and Technology (Kwame Tech), Cape Coast North with the Cape Coast Technical University, Sunyani West with the Catholic University of Ghana or Ajumako-Enyan-Essiam with the University of Education.

B | Relocations

Top relocations

The largest home relocations over the period were towards the Greater Accra region; the top 4 relocations being from Eastern Region to Greater Accra (6.6% of all relocations), Central Region to Greater Accra (5.3% of all relocations), Ashanti Region to Greater Accra (4.7% of all relocations) and Volta Region to Greater Accra (3.4% of all relocations). Greater Accra has seen an increase in residents over the period.

Relocations to/from urban areas:

Most relocations to/from the 4 urban areas considered were with neighbouring districts. Greater Accra had a net inflow, while Kumasi and Sekondi-Takoradi had a net outflow over the period. Tamale instead was relatively stable.

Details for each and long distance relocations are specified below:

Greater Accra: The largest relocations occurred with neighbouring districts (Gomoa East, Awutu Senya East, Nsawam Adoagyiri or Akuapem) but also long-distance relocations such as Ho Municipal and Tamale, or Oforikrom Municipal and Effia-Kweimintsim Municipal which were mostly departure areas (Kwame Tech being located in the Oforikrom Municipality, a large part of the relocations may be explained by the start and end of academic terms).

Kumasi: Most of the large relocations with Kumasi occurred with neighbouring districts, such as Atwima-Kwanwoma, Afigya-Kwabre South, Atwima-Nwabiagya or Ejisu Juaben (with differing incoming or outgoing relocations relationships). However, relatively smaller connections can also be found with numerous districts in Greater Accra, Sunyani or Upper Denkyira West.

Sekondi-Takoradi: Most of the large relocations with Sekondi-Takoradi also occurred with neighbouring districts, such as Shama, Ahanta West, Tarkwa-Nsuaem, or Prestea-Huni Valley. We also observe connections with Cape Coast, or many districts around Accra.

Tamale: Tamale also principally interacts with neighbouring districts, but in a more diffuse manner (i.e. over a large area, and with less variations of relocations size between connected districts). We principally observe large scale connections with the Northern, Savannah and North East Regions, but also remote locations such as Wa Municipal or numerous districts in Greater Accra. Notably, Nanumba South District is also an area with a large number of departures, but no significant arrivals from Tamale.

2 | Short term mobility

Among large daily movements in the country, the largest connections over the period also involved the Greater Accra region; the movements between Eastern Region and Greater Accra represent approximately 14% of daily flows (one way), and approximately 11% (one way) between Central Region and Greater Accra. Most other daily movements involved the Ashanti region, Central and Eastern, or Bono and Bono East Regions. We also observe movements between the Northern and Savannah Region, which in contrast seem relatively disconnected from the rest of the country.

Daily travels are generally constant over time with the exception of the start of the pandemic when mobility restrictions resulted, as intended, in a large drop to travel in all regions. This can be seen in the average distance travelled (which is an indicator relatively robust to phone use bias). A large drop in distances travelled in the country can be observed from mid to end of March 2020, a consequence of the COVID-19 pandemic and the mobility restrictions put in place at the time (nationwide school closures, bans on public gatherings, lockdowns). At a quick glance, this situation seemed to have recovered to normal levels (i.e. pre-pandemic mobility) by the end of 2021 and has remained stable or slightly increasing since.

Greater Accra: A large proportion of daily movements with Greater Accra involved the neighbouring districts of Gomoa East, Awutu Senya East, Nsawam Adoagyire or Akuapim (estimate of 56%). Those districts are located on three national highways entering the region (N1, N4 and N6). Movements extend as far as Sekondi-Takoradi and Cape Coast on the western side, Kumasi and Sunyani in the north west, Aflao on the east side, and Ho and the northern parts of the Volta Region. A daily connection is also observed extending all the way with Tamale. These observations are constant over time apart from the impact of the COVID-19 mobility restrictions (a drop of daily movements of 50 to 75%, for Greater Accra and Accra Metro respectively).

Kumasi: Here, daily movements were relatively well distributed in districts around the city, with perhaps larger movements with the south west and north east districts next to the city. This can be explained by the relatively central position of Kumasi in the national highway system of Ghana. Movements extend to all surrounding large cities: Accra, Cape Coast, Sekondi-Takoradi, Sunyani, Techiman and Tamale. Over the time period, a large drop is also observed (approximately 60 to 65%) during the pandemic onset period.

Sekondi-Takoradi: A large fraction of movements involve the east and west districts (compared to Sekondi-Takoradi) of Shama and Ahanta West (estimate of 60%), following the N1 highway crossing the city. Most of the travels occurred along the gulf of Guinea coastline, from the western border of the country to Greater Accra, with small incursions in the Western and Central Region. A daily connection is also observed extending with Tamale (which is probably a plane connection). Over the time period, a drop is also observed (approximately 35 to 40%) during the pandemic onset period, and a number of dates in 2022 are flagged with sudden large increases in daily travels.

Tamale: Approximately 60% of movements originated or passed through the west to north districts (compared to Tamale) of Gonja Central, North East Gonja, Kumbungu, Savelugu Municipal and Nanton. As for relocations, daily travels mostly occur with the surrounding North East, Northern and Savannah regions, with longer connections to Wa, Kumasi or Greater Accra. Over the time period, no abnormal values are directly flagged based on statistics, although a drop can also be seen here during the pandemic onset period (approximately 35%). We also observe a large increase in daily travels (between 25 and 50%) from November 2021 and onward. This shift may partly be explained by an increasing trend in phone usage in the area during 2021.

These travel statistics may be partly driven by variations in phone usage, in particular due to the impacts of the COVID-19 pandemic. Over the time period and for the whole country, subscribers numbers and phone event numbers generally have a rapid downward trend between March and May 2020, followed by a slow recovery to baseline values until mid 2021. However the changes in mobility were so large at this time that the travel indicators are likely to predominantly reflect them, rather than changes in phone usage, as also shown by the distance travelled indicator which is more robust to changes in phone use. We also observe a noticeable downward shift in numbers in November 2022, caused by the new policy on SIM cards registration. These events can possibly influence some of our statistics of movement over the time period, and possibly more so in some regions than others.

About the report

Authors and contributors

This report was authored by the Flowminder Foundation, working in partnership with Ghana Statistical Service (GSS) and Vodafone Ghana. Since 2018, Vodafone Ghana, Flowminder and GSS have been working together in the Data for Good partnership to build a sustainable framework for integrating mobile phone data into the production of national statistics, including strengthening the capacity of GSS to routinely produce the types of analysis described in this report.

Flowminder Foundation

This report was authored by Romain Goldenberg and Veronique Lefebvre, with contributions from James Harrison, Thomas Smallwood, Sophie Delaporte, Richard Attandoh, and Cathy Riley.

Romain Goldenberg analysed, interpreted and wrote the report; Veronique Lefebvre directed the analysis; James Harrison produced the long term mobility aggregates derived from CDR data; Thomas Smallwood supported with mobility scaling and exploratory work; Sophie Delaporte supported with report writing and data visualisation; Richard Attandoh provided in-country coordination; and Cathy Riley supported with report writing and project oversight.

Ghana Statistical Service (GSS)

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Acknowledgements

This study was made possible thanks to the anonymised data provided by Vodafone Ghana.

This work has also been possible thanks to funding from the William and Flora Hewlett Foundation and Vodafone Foundation.

About the data

The population and mobility estimates presented in this report are derived from Call Detail Records (a form of mobile phone usage data) and other datasets for adjustments. However, these are not traditional population and survey estimates. Readers who are unfamiliar with this data source, are encouraged to read explanatory documentation which can be found on Flowminder's CDR data analytics Knowledge Centre ([FlowGeek](#)) or a more detailed description of indicators hosted on the [Haiti Mobility Data Platform](#), which uses the same methods as this report.

Long term mobility estimates (*estimates of residents and relocations*) are produced from mature and robust methods, meaning that they have been corrected to make the indicators representative of the whole population (instead of representing only Vodafone Ghana's subscribers) as well as to reduce the influence of varying phone usage. For this beta analysis, it is worth noting that the indicators have been scaled to be representative of the population using a gridded population counts dataset for 2020 ([source here](#)). For the final version of the report, we will instead use a recent Ghana household survey, implemented in 2022.

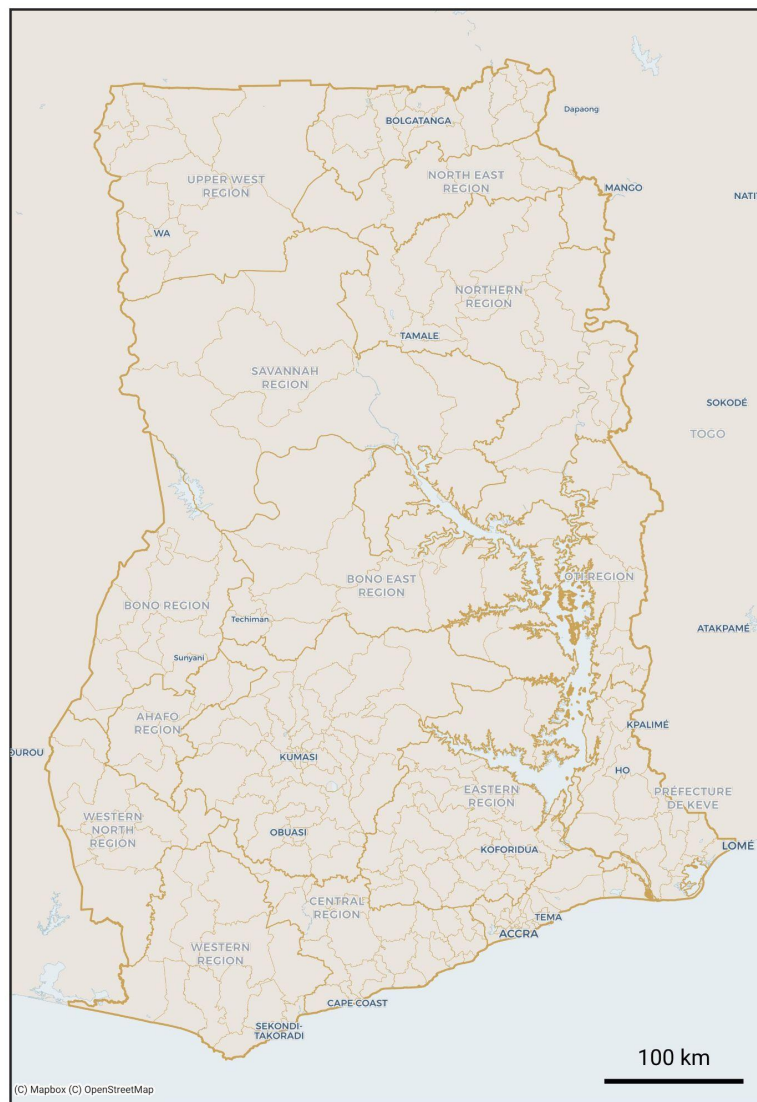
Shorter-term mobility estimates (*daily movements/travels*) are currently classified as experimental. This is because we cannot yet provide estimates of daily travellers corrected and adjusted to the general population, which affects the value of statistics and the comparison across regions and over time. Further, mobility and phone usage are conflated in these statistics, and development of further methods is required to extract short term (daily, hourly) mobility information from CDRs. As such, they should be interpreted with caution. Method development to address these issues is ongoing.

Figures | Understanding the graphs

All the figures in this report show data for the time period from **01 January 2020 to 31 December 2022**. When used for an analysis, the baseline value is defined as the median value of the metric of interest across this reference period.

Except for the case of exploring trip size distances (in kilometres), all the data presented here measure relative values (not absolute values). In particular, values of visualisations based on daily or monthly time series (monthly resident count trends, or time series of daily travels) are displayed as change relative to the baseline value. Spatial visualisations of flows (monthly resident relocations and daily trips flows between locations) are measured as proportions, i.e. the relative size of an individual flow compared to the sum of all other flows, across the chosen time period. The size measurement of an individual flow is initially calculated as the median of the time series values across the full time period.

For context, below is included a map of Ghana showing regions and districts:



1 | Long term mobility

1.1 | Monthly population estimates (residents)

In this section, we focus on monthly resident trends, i.e. the estimated variation in the number of people whose home location is within an area of interest.

We look at whether a population is stable, increasing or decreasing (and whether or not this trend is fluctuating - i.e. contain months with abnormal changes compared to the usual trend) in the period 2020-2022 and for each area of interest.

1.1.1 | Population trends in the country

1.1.1.1 | Spatial trends

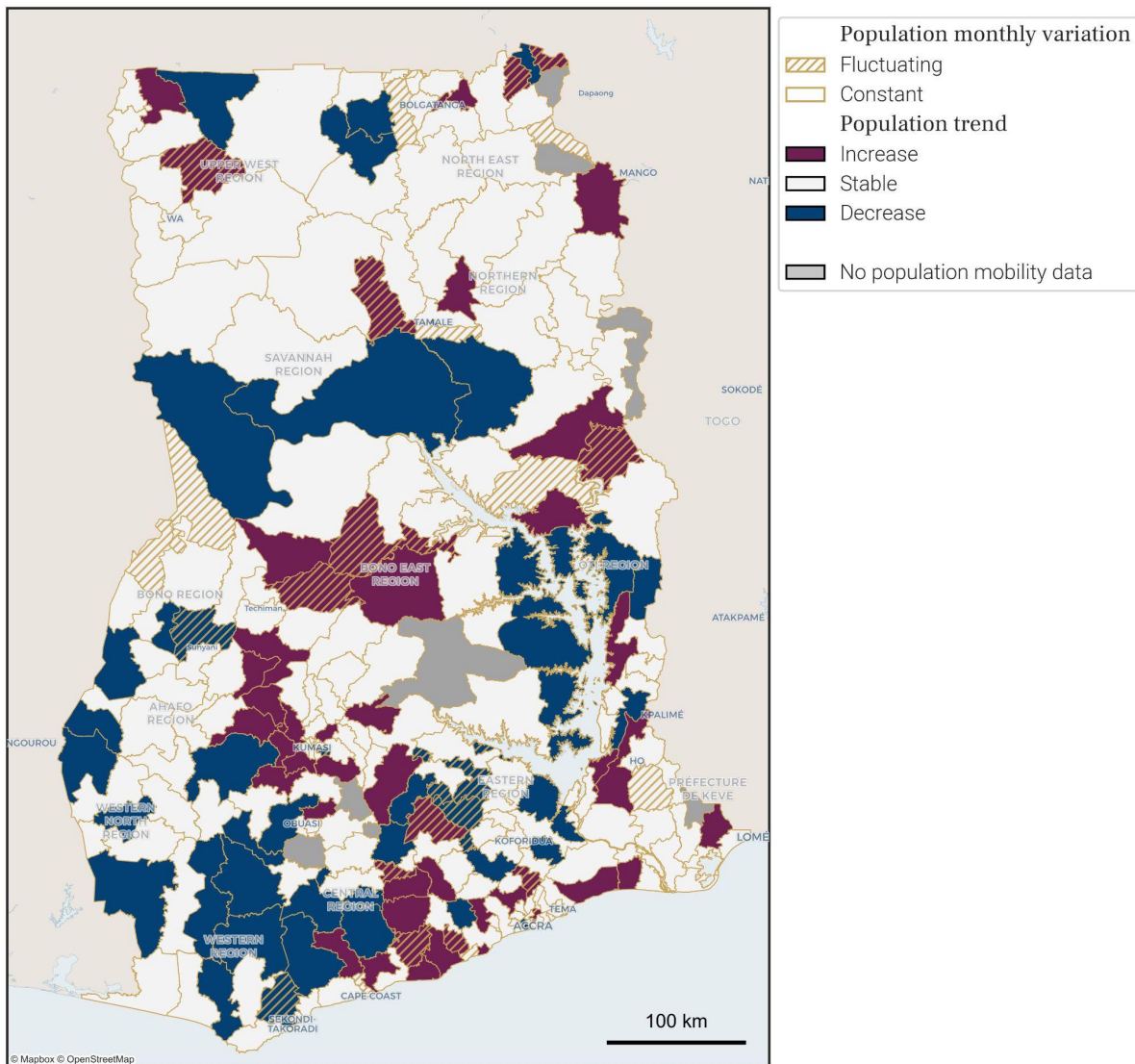


Figure 1.1.1.1 | Resident trends per district in Ghana over the period 2020 to 2022.

1.1.1.2 | Monthly time series of relative change in residents

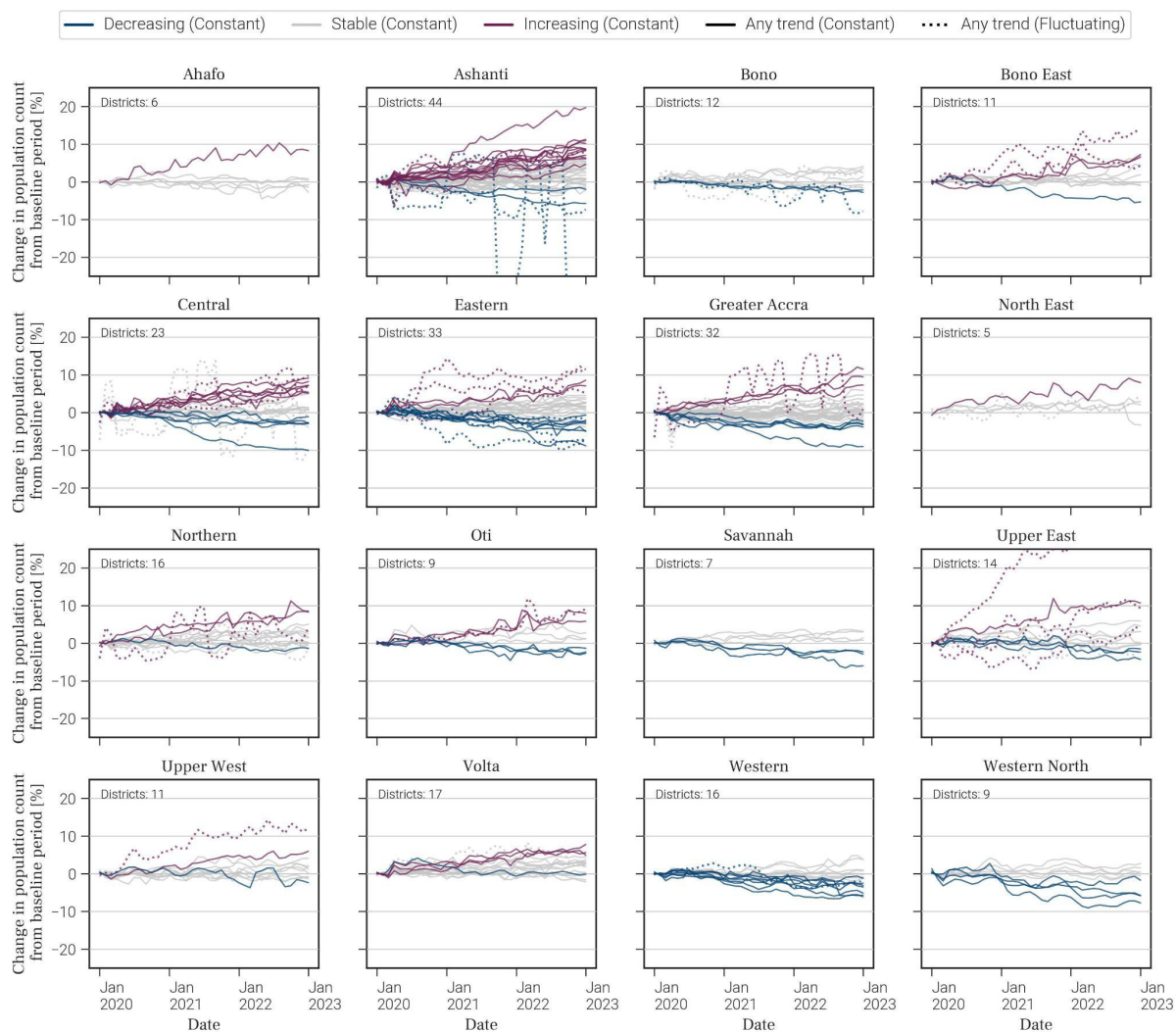


Figure 1.1.1.2 | Monthly time series of change in residents count, organised per region for each district over the period 2020 to 2022.

1.1.1.3 | Population statistics table

Tendency	Variation	Number of districts	Total population start	Population start (% of total)	Total population end	Population end (% of total)
Decreasing	Constant	45	444'3117	14.7 %	4'275'058	14.0 %
Decreasing	Fluctuating	7	1'040'303	3.4 %	819'639	2.7 %
Stable	Constant	152	18'971'901	62.6 %	19'181'744	62.8 %
Stable	Fluctuating	10	937'134	3.1 %	951'785	3.1 %
Increasing	Constant	36	3'397'005	11.2 %	3'659'086	12.0 %
Increasing	Fluctuating	15	1'509'548	5.0 %	1'668'352	5.5 %

Table 1.1.1.3 | Categories of resident trends, with associated districts and population statistics in Ghana.

1.1.2 | Population trends in Greater Accra

1.1.2.1 | Spatial trends

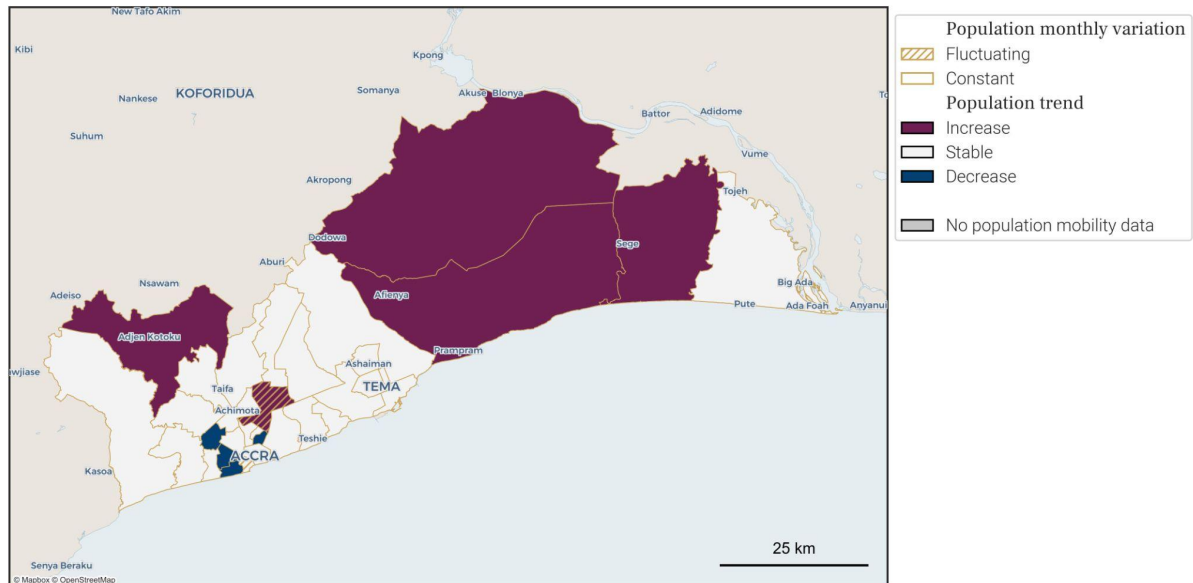


Figure 1.1.2.1 | Resident trends per district in Greater Accra over the period 2020 to 2022.

1.1.2.2 | Population statistics table

Tendency	Variation	Number of districts	Total population start	Population start (% of total)	Total population end	Population end (% of total)
Decreasing	Constant	4	600'266	11.3 %	573'484	10.7 %
Stable	Constant	22	3'834'724	72.1 %	3'849'719	71.7 %
Stable	Fluctuating	1	81'824	1.5 %	83'976	1.6 %
Increasing	Constant	4	432'981	8.1 %	468'922	8.7 %
Increasing	Fluctuating	1	365'234	6.9 %	394'605	7.3 %

Table 1.1.2.2 | Categories of resident trends, with associated districts and population statistics in Greater Accra.

1.1.3 | Population trends in Kumasi

1.1.3.1 | Spatial trends

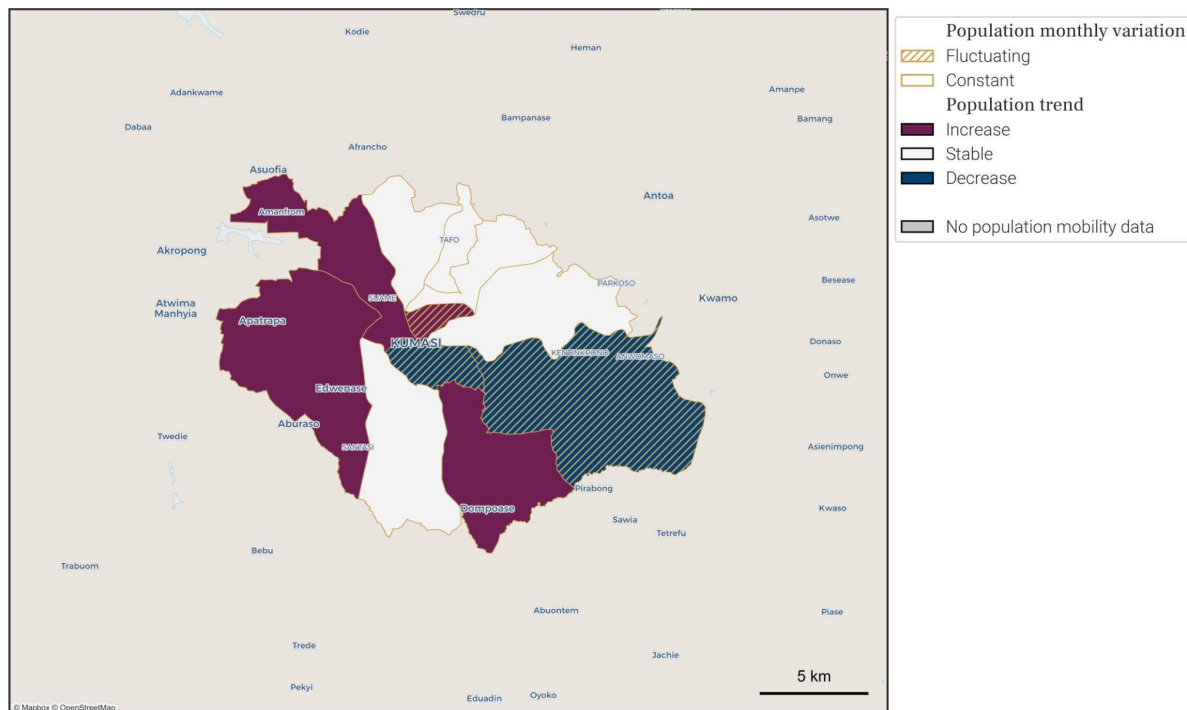


Figure 1.1.3.1 | Resident trends per district in Kumasi over the period 2020 to 2022.

1.1.3.2 | Population statistics table

Tendency	Variation	Number of districts	Total population start	Population start (% of total)	Total population end	Population end (% of total)
Decreasing	Fluctuating	2	653'236	21.1 %	453'185	15.6 %
Stable	Constant	5	1'114'650	36.0 %	1'098'669	37.7 %
Increasing	Constant	3	1'262'846	40.8 %	1'286'475	44.2 %
Increasing	Fluctuating	1	67'065	2.2 %	72'449	2.5 %

Table 1.1.3.2 | Categories of resident trends, with associated districts and population statistics in Kumasi.

1.1.4 | Population trends in Sekondi-Takoradi

1.1.4.1 | Spatial trends

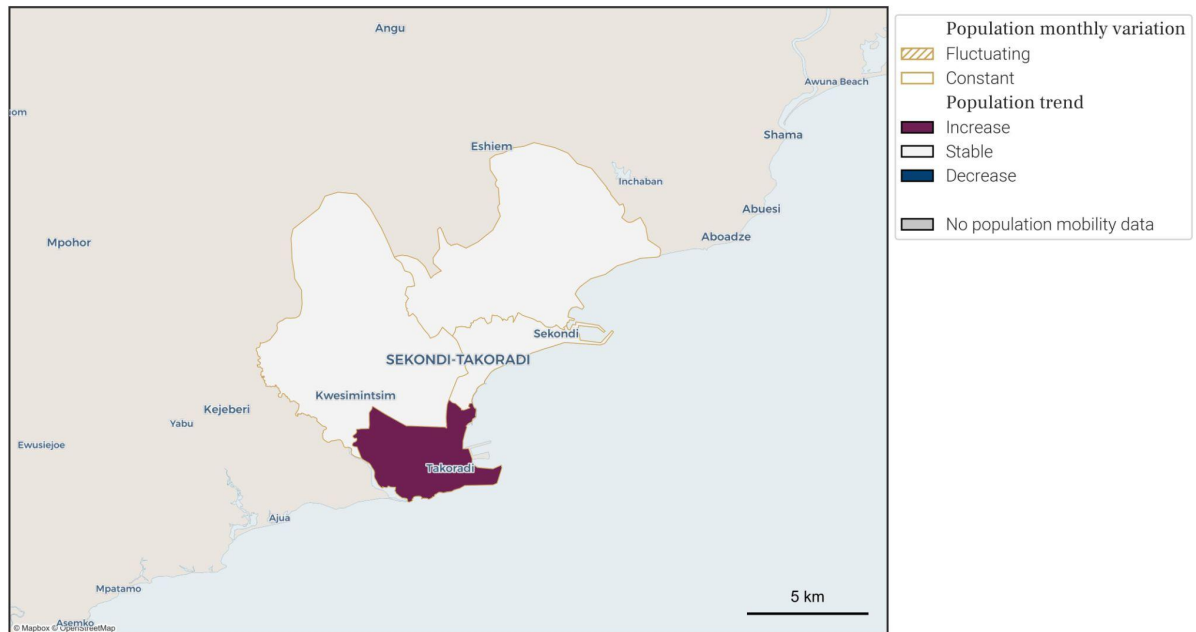


Figure 1.1.4.1 | Resident trends per district in Sekondi-Takoradi over the period 2020 to 2022.

1.1.4.2 | Population statistics table

Tendency	Variation	Number of districts	Total population start	Population start (% of total)	Total population end	Population end (% of total)
Stable	Constant	3	687'483	85.8 %	673'027	85.0 %
Increasing	Constant	1	114'191	14.2 %	118'871	15.0 %

Table 1.1.4.2 | Categories of resident trends, with associated districts and population statistics in Sekondi-Takoradi.

1.1.5 | Population trends in Tamale

1.1.5.1 | Population statistics table

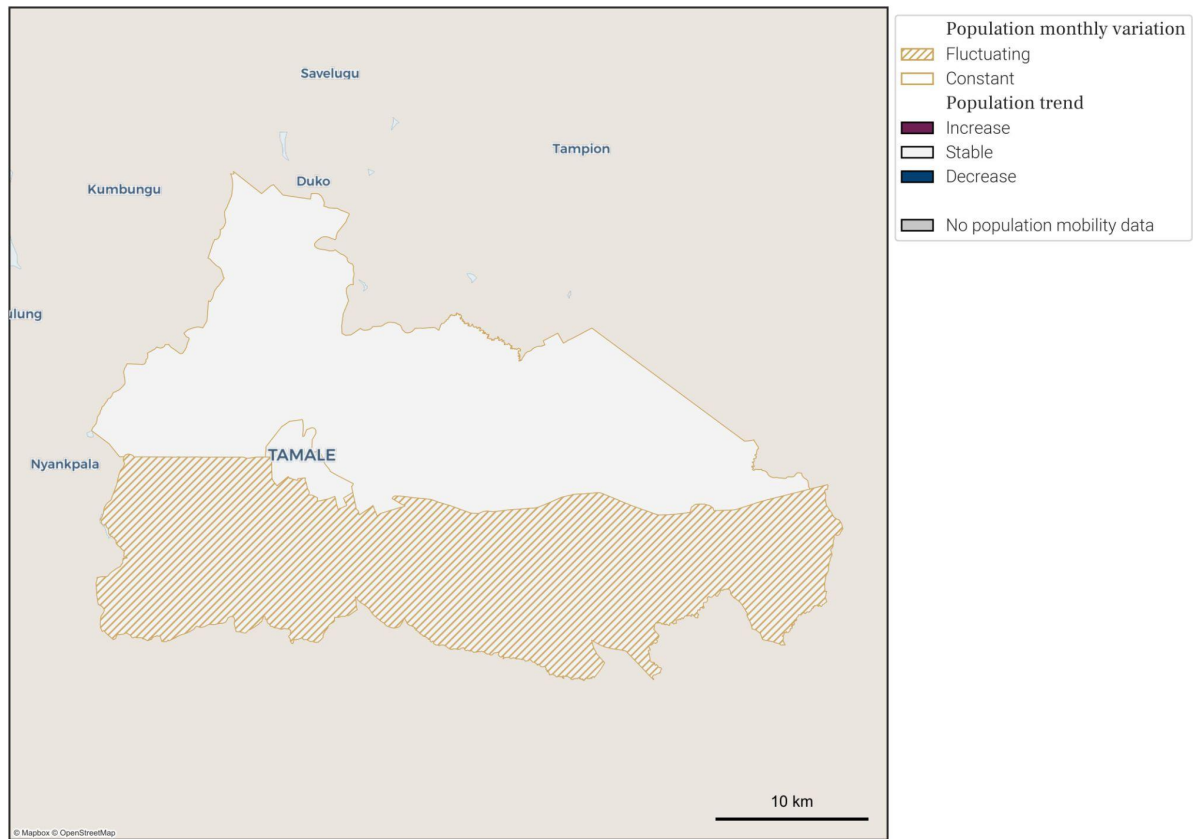


Figure 1.1.5.1 | Resident trends per district in Tamale over the period 2020 to 2022.

1.1.5.2 | Population statistics table

Tendency	Variation	Number of districts	Total population start	Population start (% of total)	Total population end	Population end (% of total)
Stable	Constant	2	309'577	70.7 %	308'407	70.7 %
Stable	Fluctuating	1	128'582	29.3 %	127'828	29.3 %

Table 1.1.5.2 | Categories of resident trends, with associated districts and population statistics in Tamale.

1.2 | Relocations

In this section we focus on people's relocations, i.e. the estimated number of persons relocating (i.e. changing their home location) between areas of interest. Each relocation measurement is initially calculated using the monthly median value of all people relocating, in the period 2020-2022 and the area of interest. We then display the average size of relocations (i.e. proportion compared to all other relocations) for each of the pairwise areas of interest. We look first at the largest relocations between regions, and then separately at relocations from and to areas of interest

1.2.1 | Largest relocations (top 30) at the national level

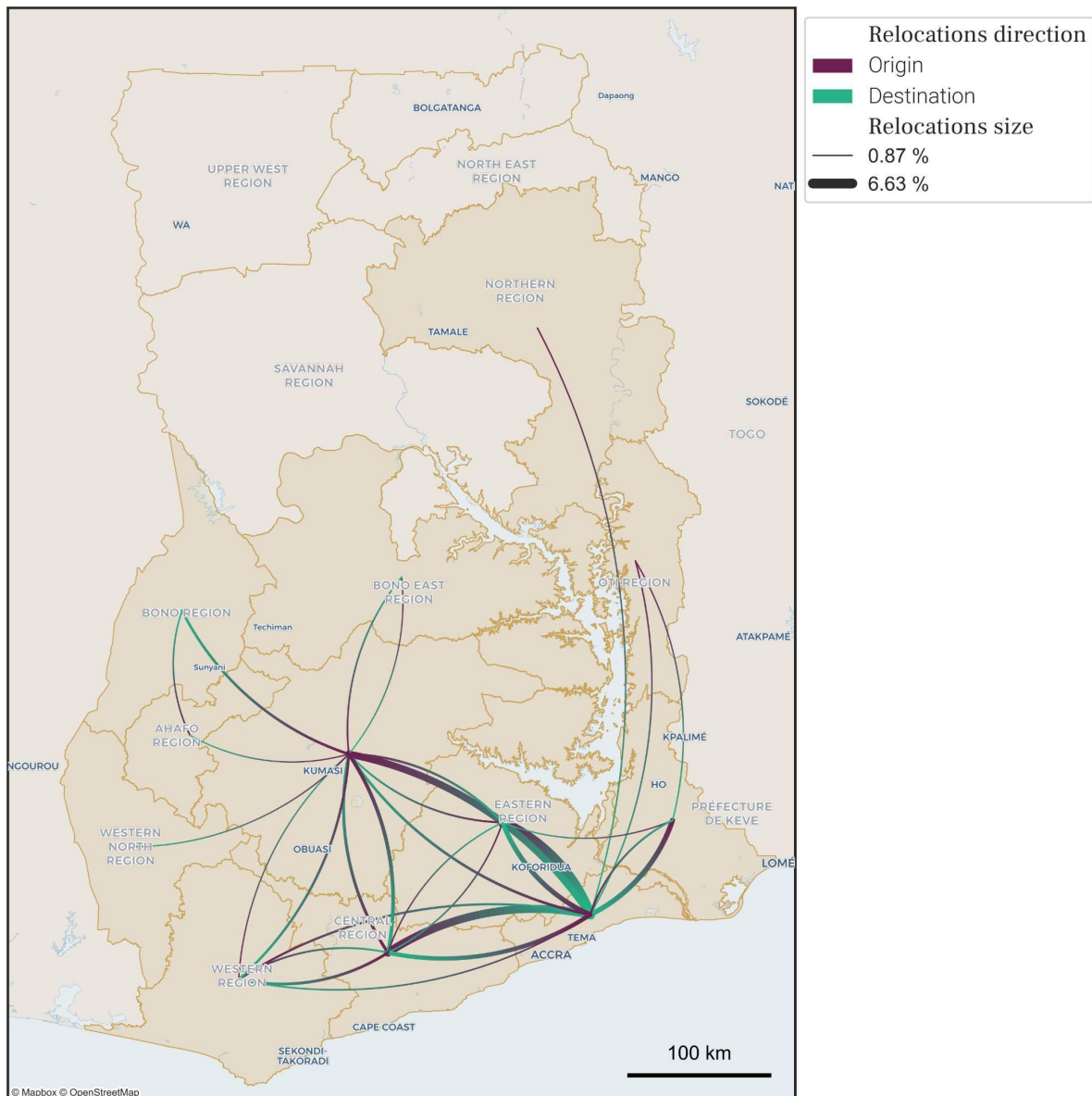


Figure 1.2.1 | Top 30 largest relocations between regions in Ghana by relative size (compared to all relocations between regions), over the period 2020 to 2022.

1.2.2 | Relocations with Greater Accra

1.2.2.1 | Relocations incoming to districts from Greater Accra

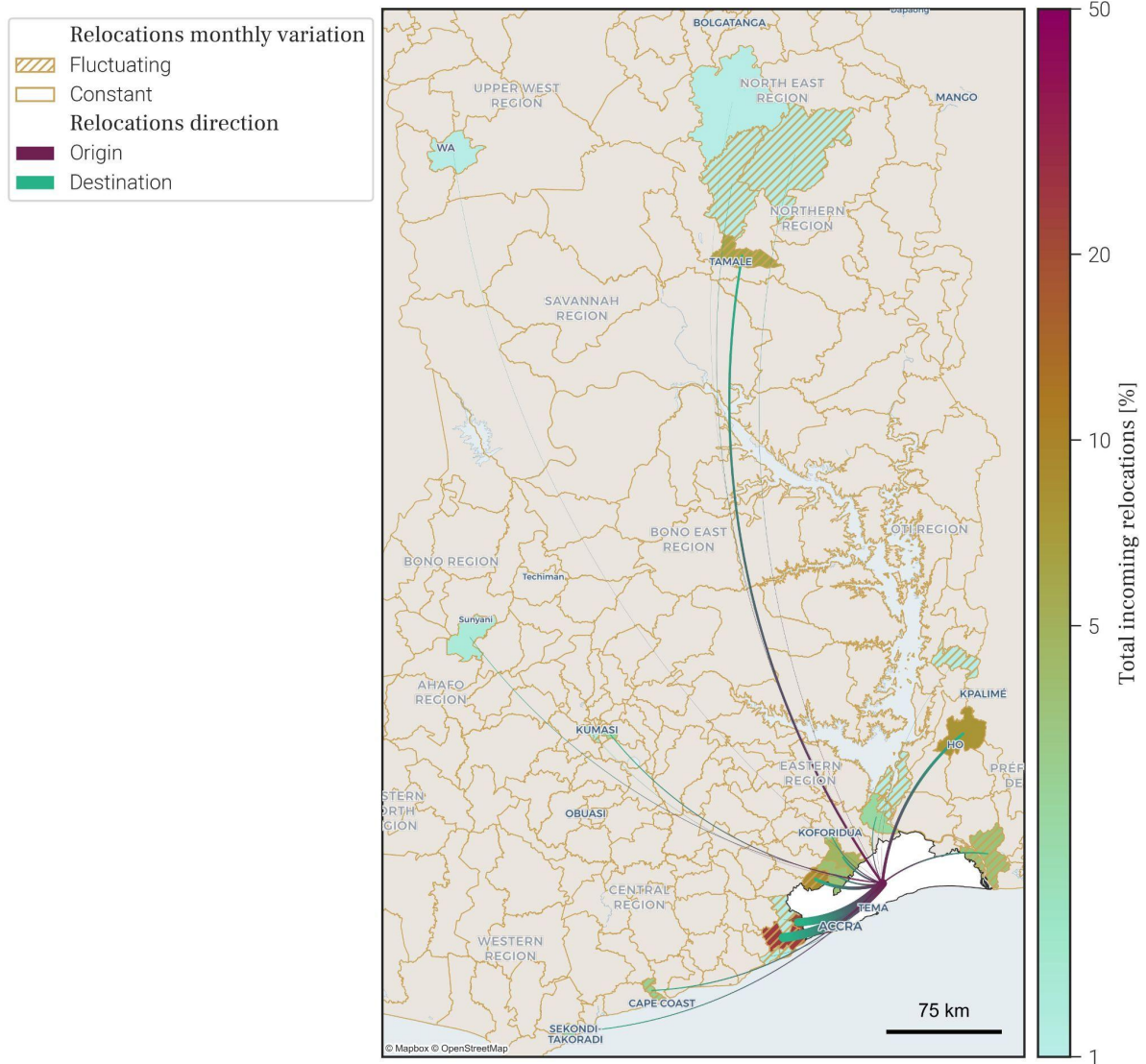


Figure 1.2.2.1 | Relative size of all relocations incoming to districts in Ghana from Greater Accra, over the period 2020 to 2022.

1.2.2.2 | Relocations outgoing from districts to Greater Accra

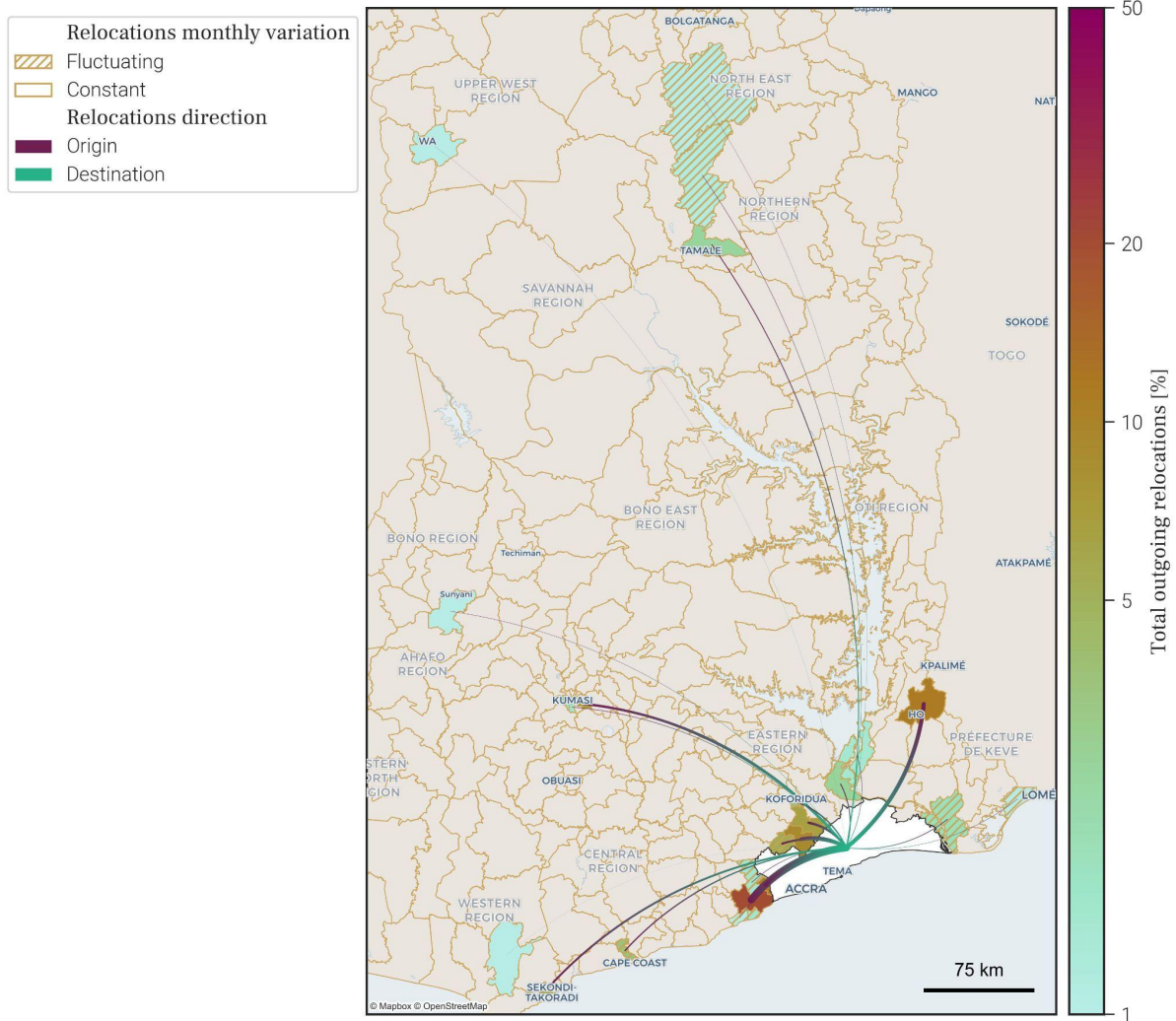


Figure 1.2.2.2 | Relative size of all relocations outgoing from districts in Ghana to Greater Accra, over the period 2020 to 2022.

1.2.3 | Relocations with Kumasi

1.2.3.1 | Relocations incoming to districts from Kumasi

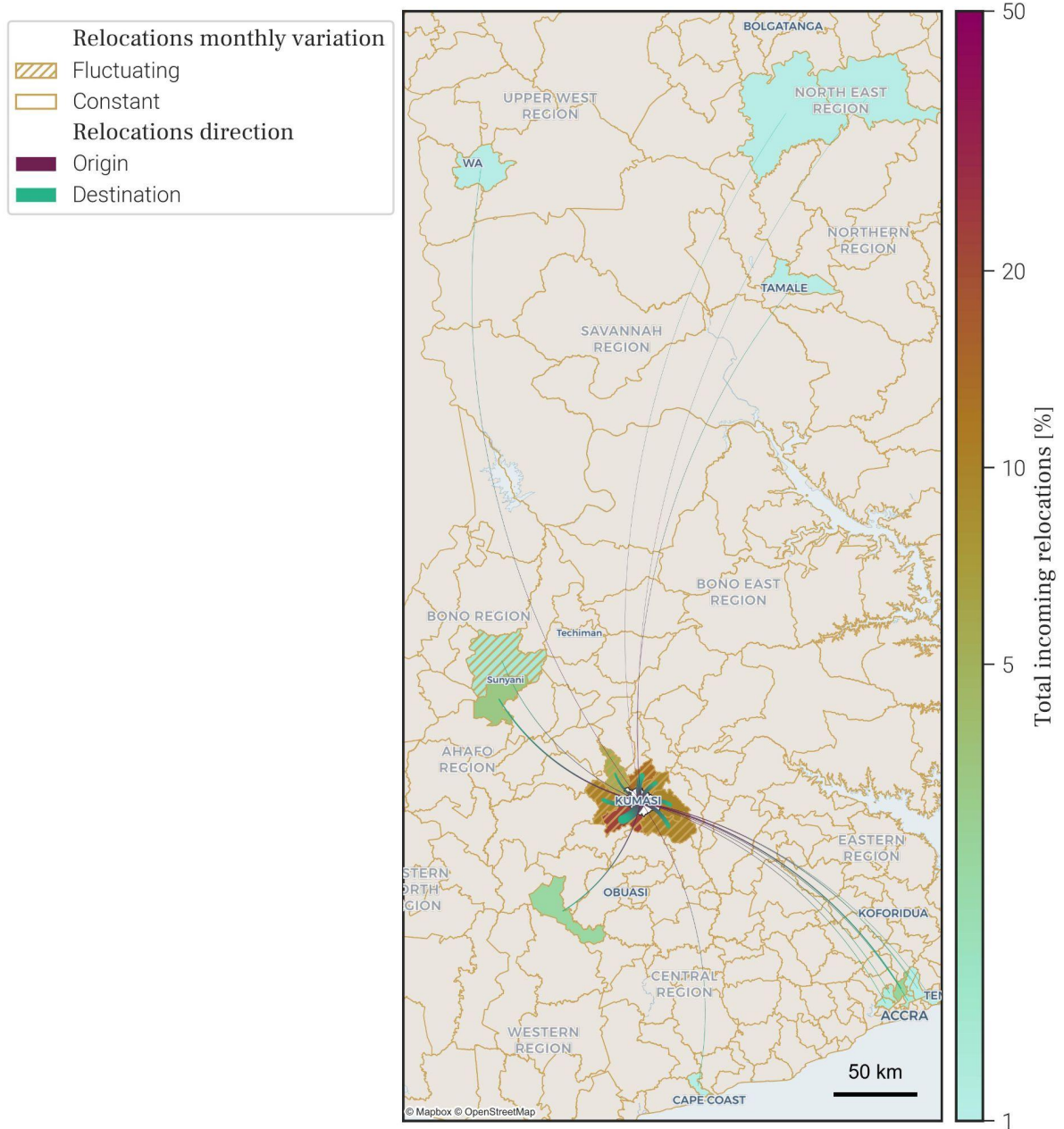


Figure 1.2.3.1 | Relative size of all relocations incoming to districts in Ghana from Kumasi, over the period 2020 to 2022.

1.2.3.2 | Relocations outgoing from districts to Kumasi

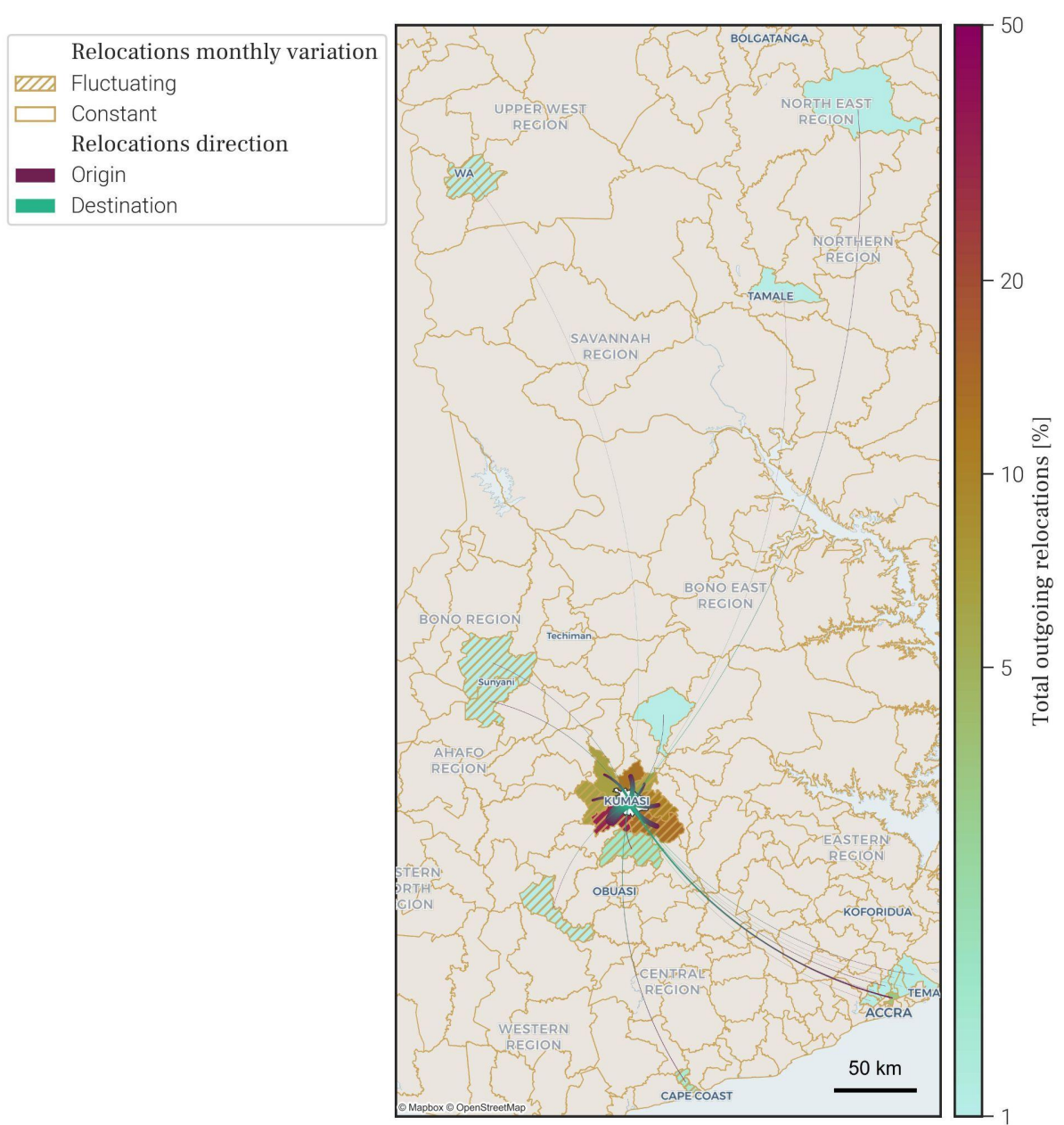


Figure 1.2.3.2 | Relative size of all relocations outgoing from districts in Ghana to Kumasi, over the period 2020 to 2022.

1.2.4 | Relocations with Sekondi-Takoradi

1.2.4.1 | Relocations incoming to districts from Sekondi-Takoradi

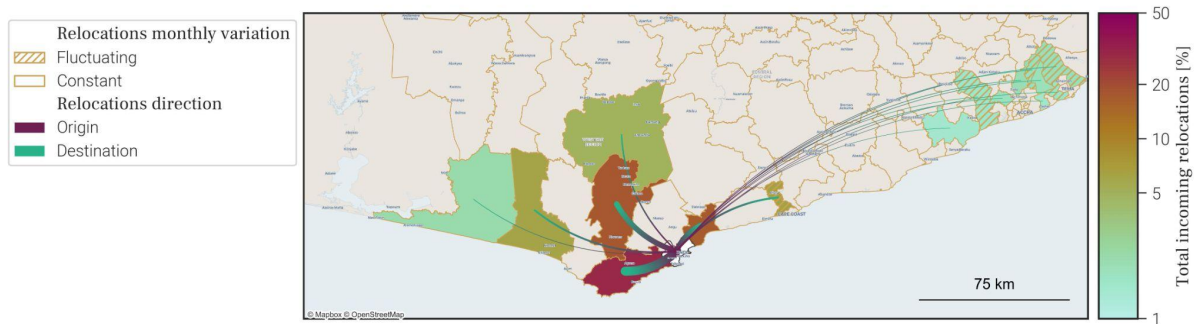


Figure 1.2.4.1 | Relative size of all relocations incoming to districts in Ghana from Sekondi-Takoradi, over the period 2020 to 2022.

1.2.4.2 | Relocations outgoing from districts to Sekondi-Takoradi

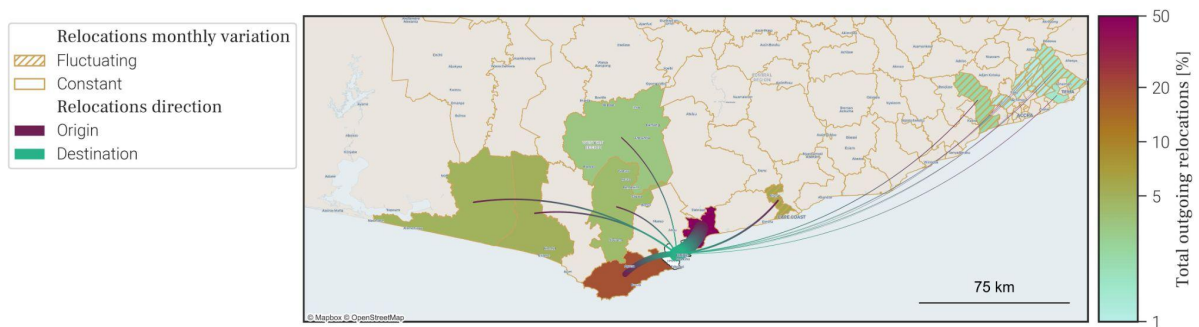


Figure 1.2.4.2 | Relative size of all relocations outgoing from districts in Ghana to Sekondi-Takoradi, over the period 2020 to 2022.

1.2.5 | Relocations with Tamale

1.2.5.1 | Relocations incoming to districts from Tamale

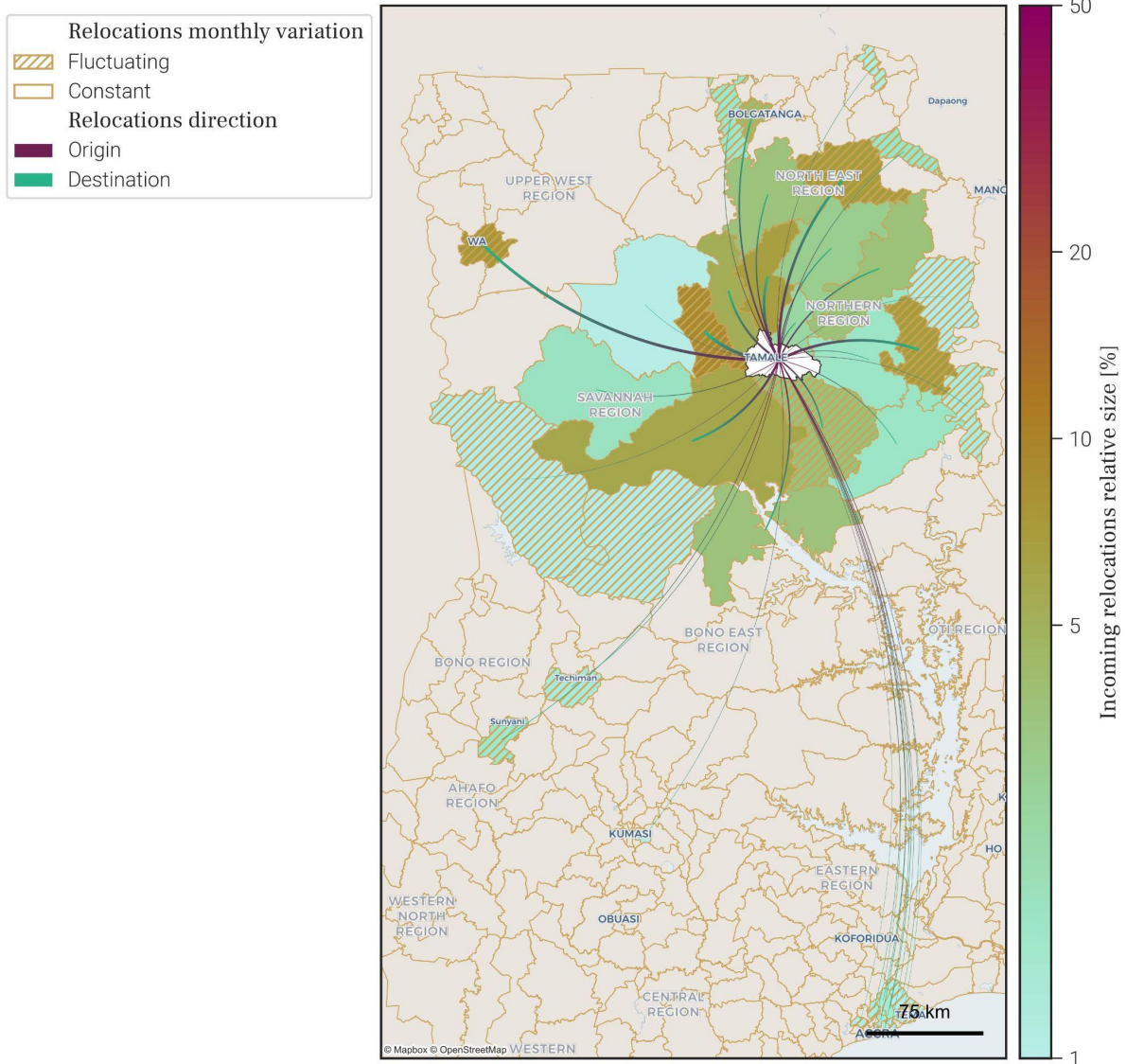


Figure 1.2.5.1 | Relative size of all relocations incoming to districts in Ghana from Tamale, over the period 2020 to 2022.

1.2.5.2 | Relocations outgoing from districts to Tamale

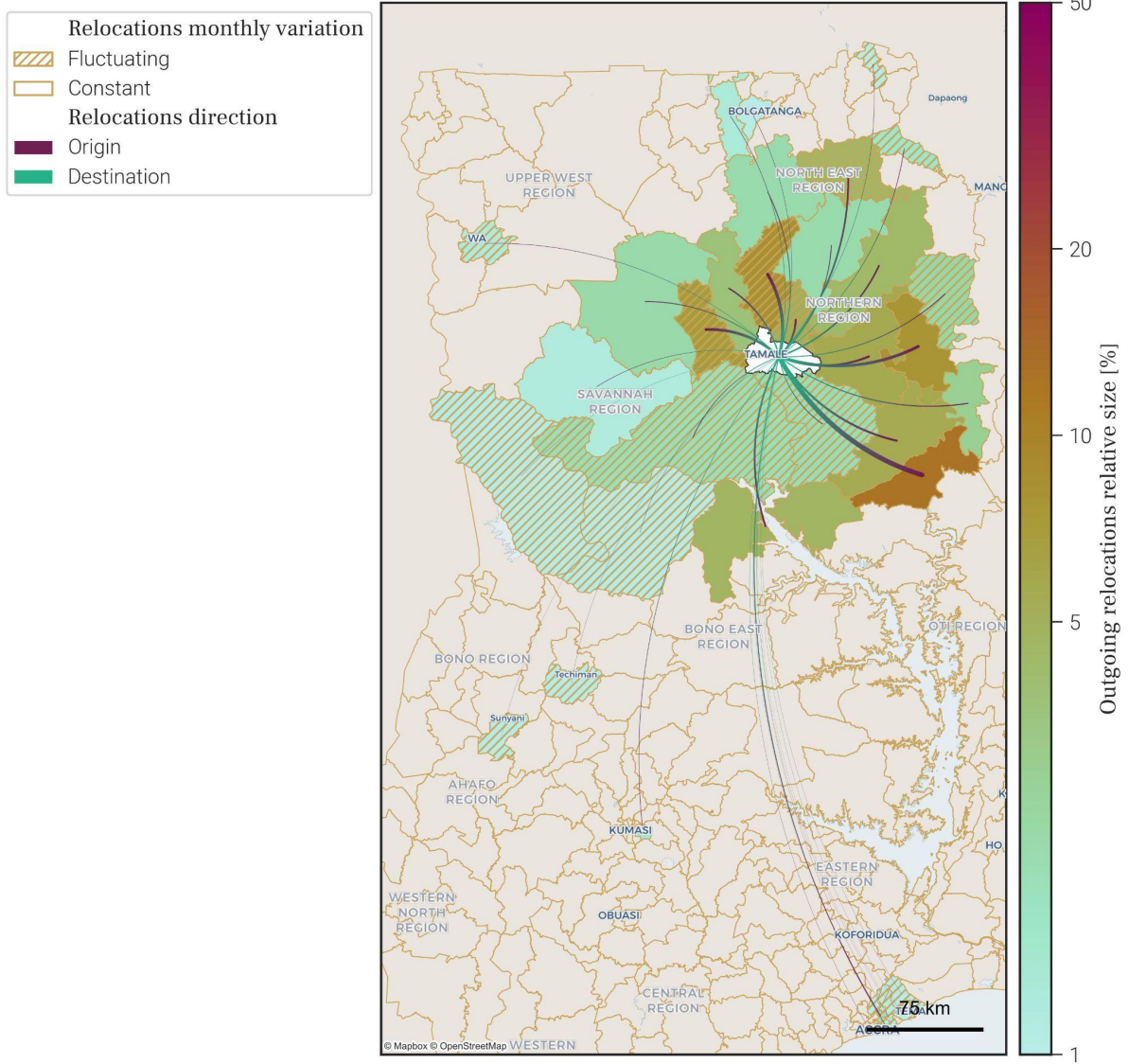


Figure 1.2.5.2 | Relative size of all relocations outgoing from districts in Ghana to Tamale, over the period 2020 to 2022.

2 | Short term mobility

In this section, we focus on short-term people's movements, i.e. the daily flows of people who are travelling into, out of and between areas.

We first look at the relative size of those flows (i.e. proportion compared to all other flows) for the largest connections, based on median values calculated in the period 2020-2022. We then measure the daily distribution of travelled distances (in kilometres) for all travellers. Finally, we look separately at flows proportions from and to areas of interest, and their associated daily time series of relative change in travels.

2.1 | Largest movements (top 30) at the national level

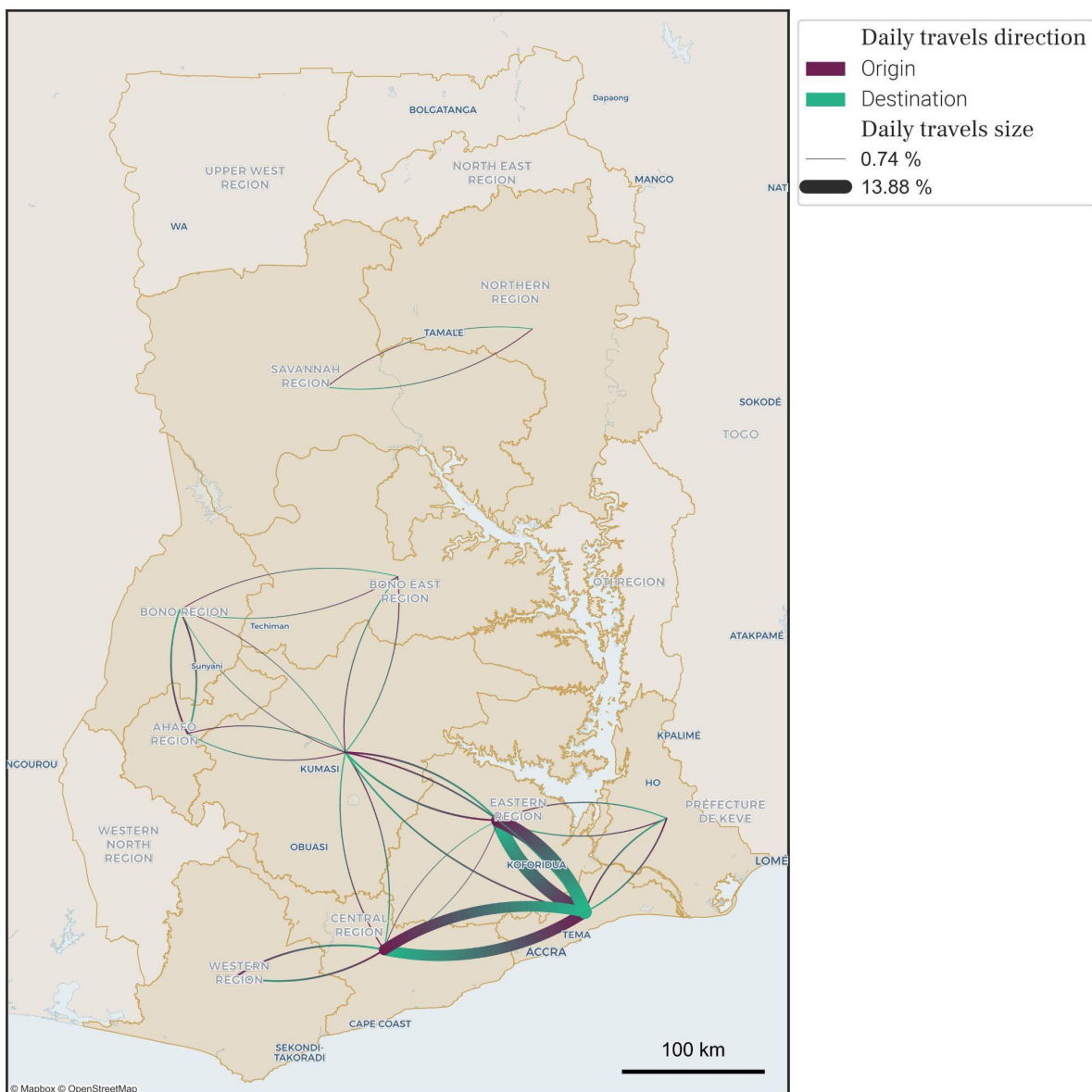


Figure 2.1 | Top 30 largest daily travel flows between regions in Ghana by relative size (compared to all daily flows between regions), over the period 2020 to 2022.

2.2 | Daily travel size distribution

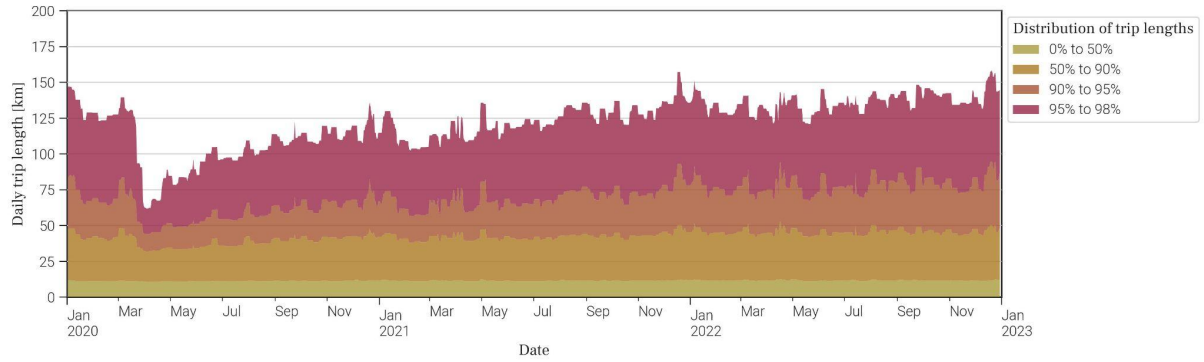


Figure 2.2 | Distribution of daily movement distances for all daily travellers in Ghana.

2.3 | Daily movements with Greater Accra

2.3.1 | Spatial trends

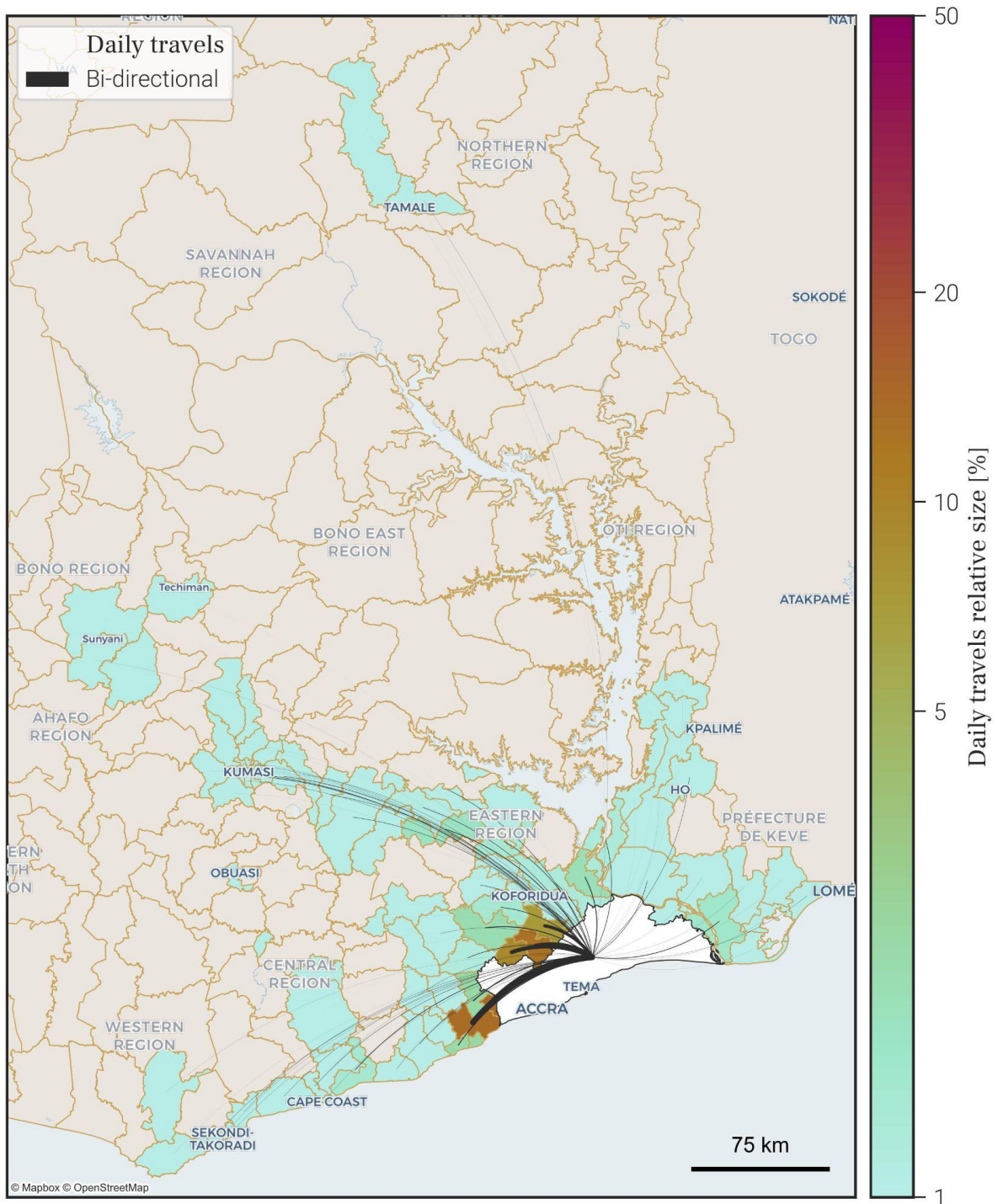


Figure 2.3.1 | Relative size of all daily travels to and from Greater Accra with other districts in Ghana, over the period 2020 to 2022.

2.3.2 | Daily time series of relative change in travellers with Greater Accra

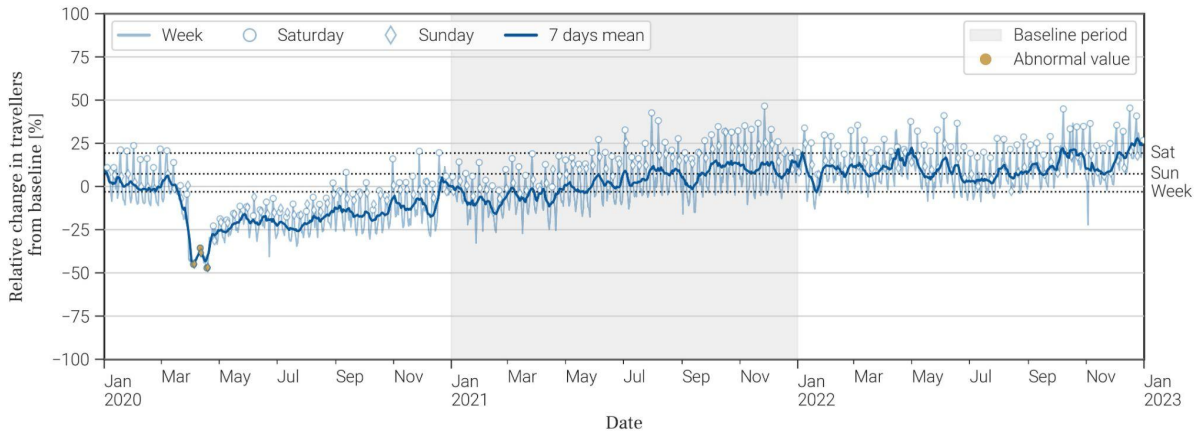


Figure 2.3.2 | Time series of relative change in travellers to and from Greater Accra with other districts in Ghana, over the period 2020 to 2022. Daily values are categorised into weekdays, Saturdays or Sundays, with associated medians over the period for each group.

2.3.3 | Abnormal values

Date	Year	Week	Day	Travellers change from reference [%]
2020 to 2021	#	#	#	COVID-19 impacts

Table 2.3.3 | Abnormal values flagged in daily travellers with Greater Accra.

2.3.4 | Daily time series of relative change in travellers with Accra Metropolitan

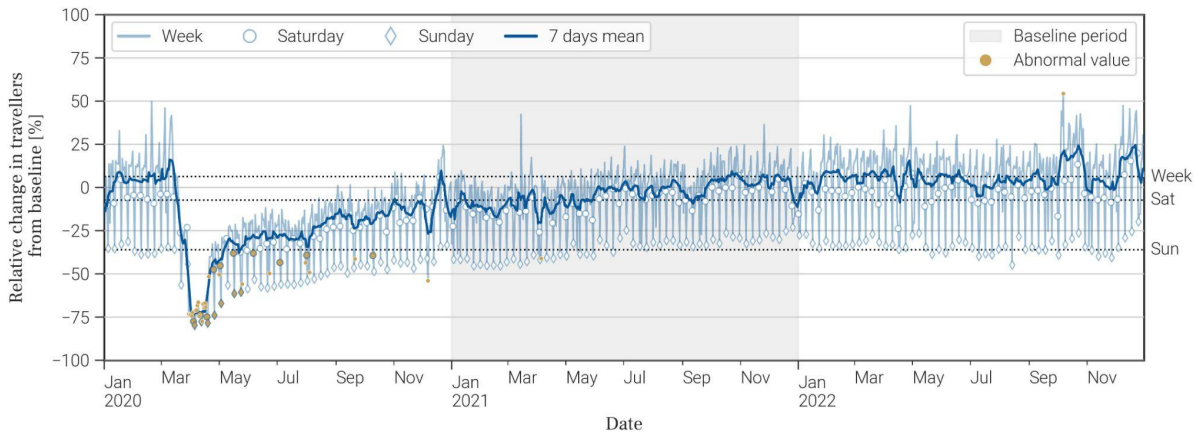


Figure 2.3.4 | Time series of relative change in travellers to and from Accra Metropolitan with other districts in Ghana, over the period 2020 to 2022. Daily values are categorised into weekdays, Saturdays or Sundays, with associated medians over the period for each group.

2.3.5 | Abnormal values

Date	Year	Week	Day	Travellers change from reference [%]
2020 to 2021	#	#	#	COVID-19 impacts
2021-04-05	2021	14	1	-41.0
2022-10-07	2022	40	5	54.3

Table 2.3.5 | Abnormal values flagged in daily travellers with Accra Metropolitan.

2.4 | Daily movements with Kumasi

2.4.1 | Spatial trends

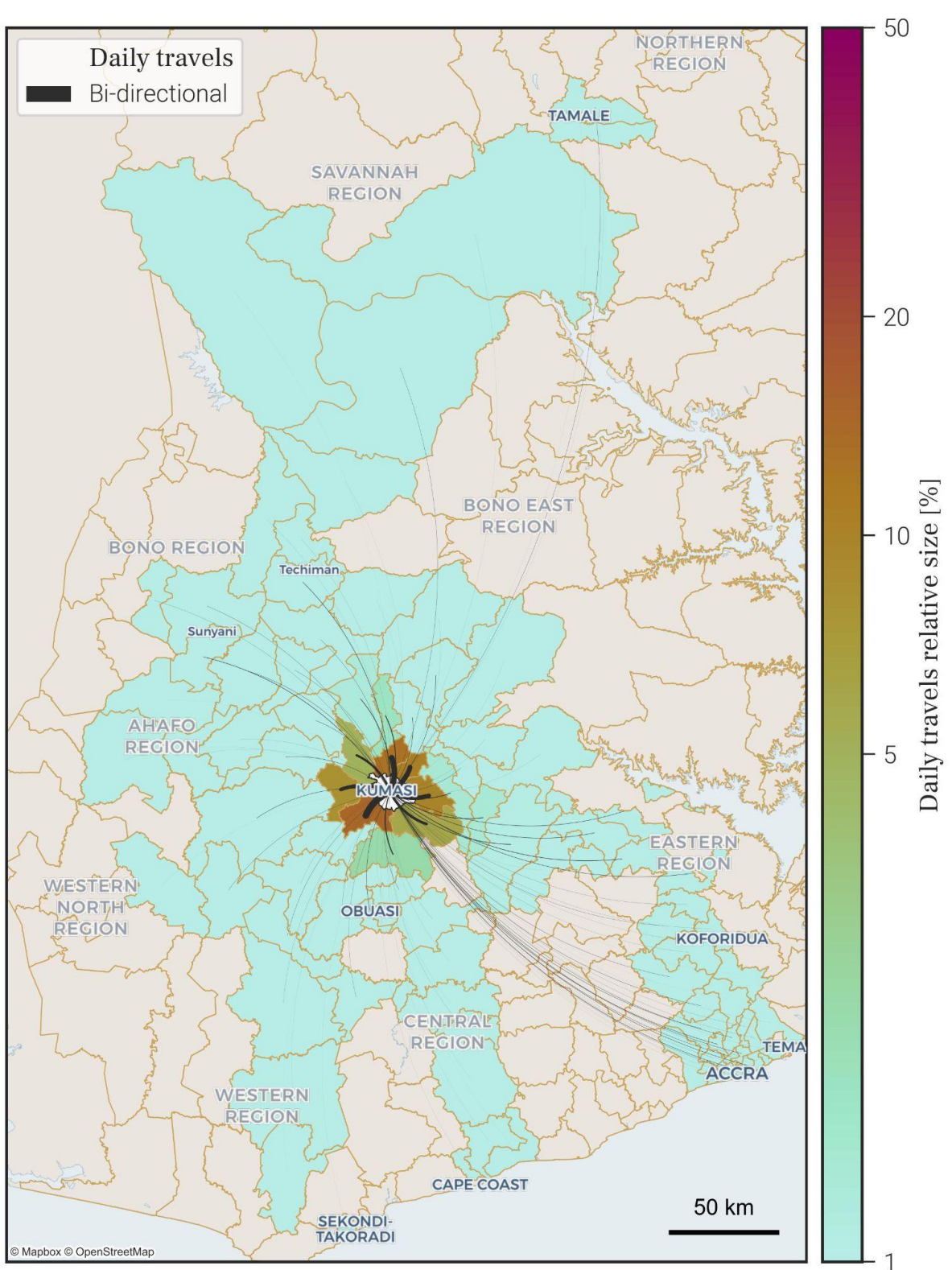


Figure 2.4.1 | Relative size of all daily travels to and from Kumasi with other districts in Ghana, over the period 2020 to 2022.

2.4.2 | Daily time series of relative change in travellers for Kumasi

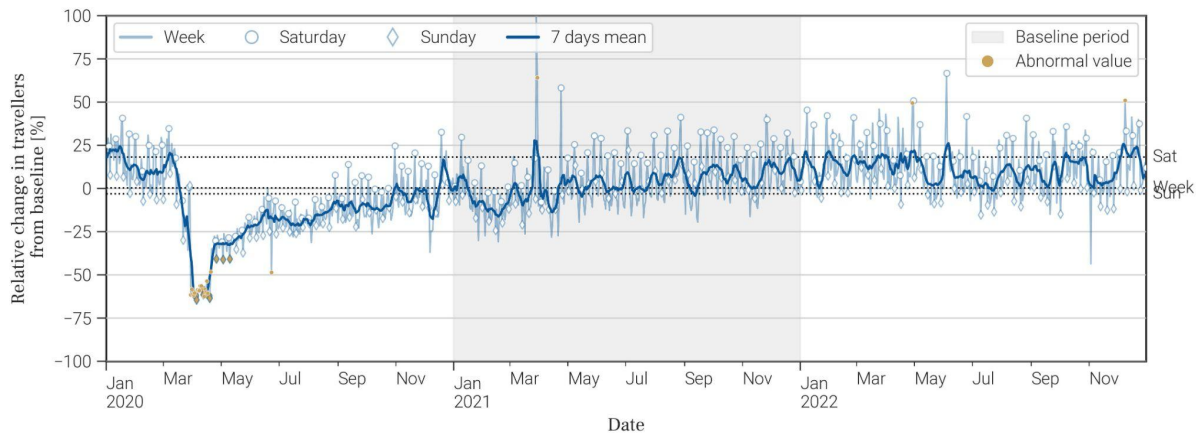


Figure 2.4.2 | Time series of relative change in travellers to and from Kumasi with other districts in Ghana, over the period 2020 to 2022. Daily values are categorised into weekdays, Saturdays or Sundays, with associated medians over the period for each group.

2.4.3 | Abnormal values

Date	Year	Week	Day	Travellers change from reference [%]
2020 to 2021	#	#	#	COVID-19 impacts
2021-03-29	2021	13	1	100.9
2021-03-30	2021	13	2	64.0
2022-04-29	2022	17	5	49.5
2022-12-09	2022	49	5	50.9

Table 2.4.3 | Abnormal values flagged in daily travellers with Kumasi.

2.5 | Daily movements with Sekondi-Takoradi

2.5.1 | Spatial trends

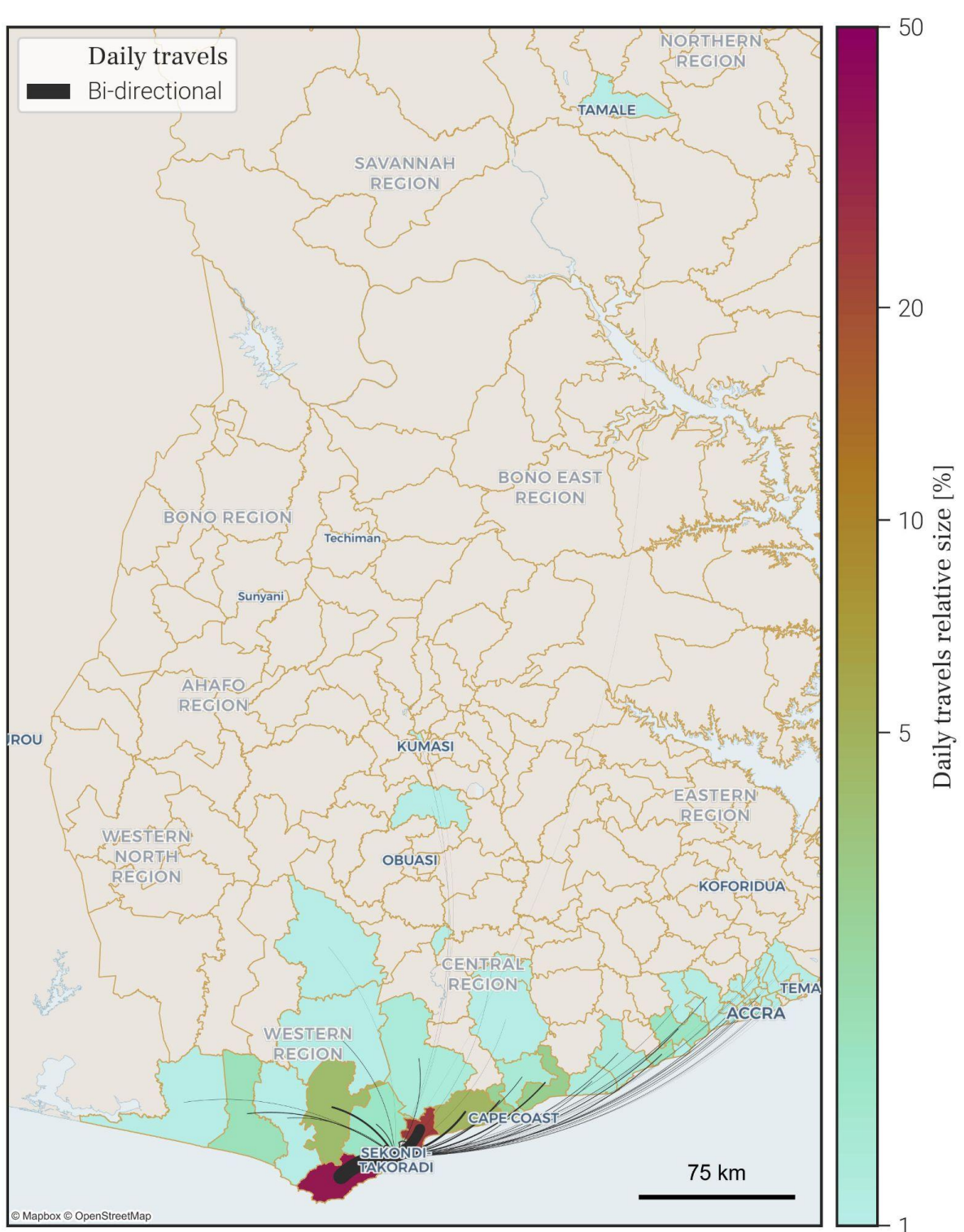


Figure 2.5.1 | Relative size of all daily travels to and from Sekondi-Takoradi with other districts in Ghana, over the period 2020 to 2022.

2.5.2 | Daily time series of relative change in travellers for Sekondi-Takoradi

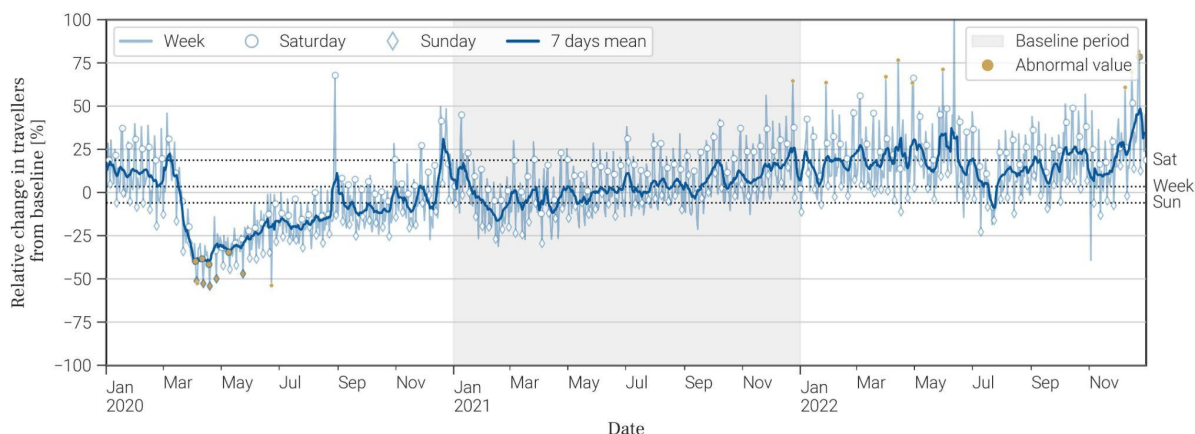


Figure 2.5.2 | Time series of relative change in travellers to and from Sekondi-Takoradi with other districts in Ghana, over the period 2020 to 2022. Daily values are categorised into weekdays, Saturdays or Sundays, with associated medians over the period for each group.

2.5.3 | Abnormal values

Date	Year	Week	Day	Travellers change from reference [%]
2020 to 2021	#	#	#	COVID-19 impacts
2021-12-24	2021	51	5	64.5
2022-01-28	2022	4	5	63.5
2022-04-01	2022	13	5	67.1
2022-04-14	2022	15	4	76.5
2022-04-29	2022	17	5	63.5
2022-05-31	2022	22	2	71.2
2022-06-12	2022	23	7	105.9
2022-12-09	2022	49	5	60.8
2022-12-16	2022	50	5	69.5
2022-12-23	2022	51	5	81.5
2022-12-24	2022	51	6	78.5

Table 2.5.3 | Abnormal values flagged in daily travellers with Sekondi-Takoradi.

2.6 | Daily movements with Tamale

2.6.1 | Spatial trends

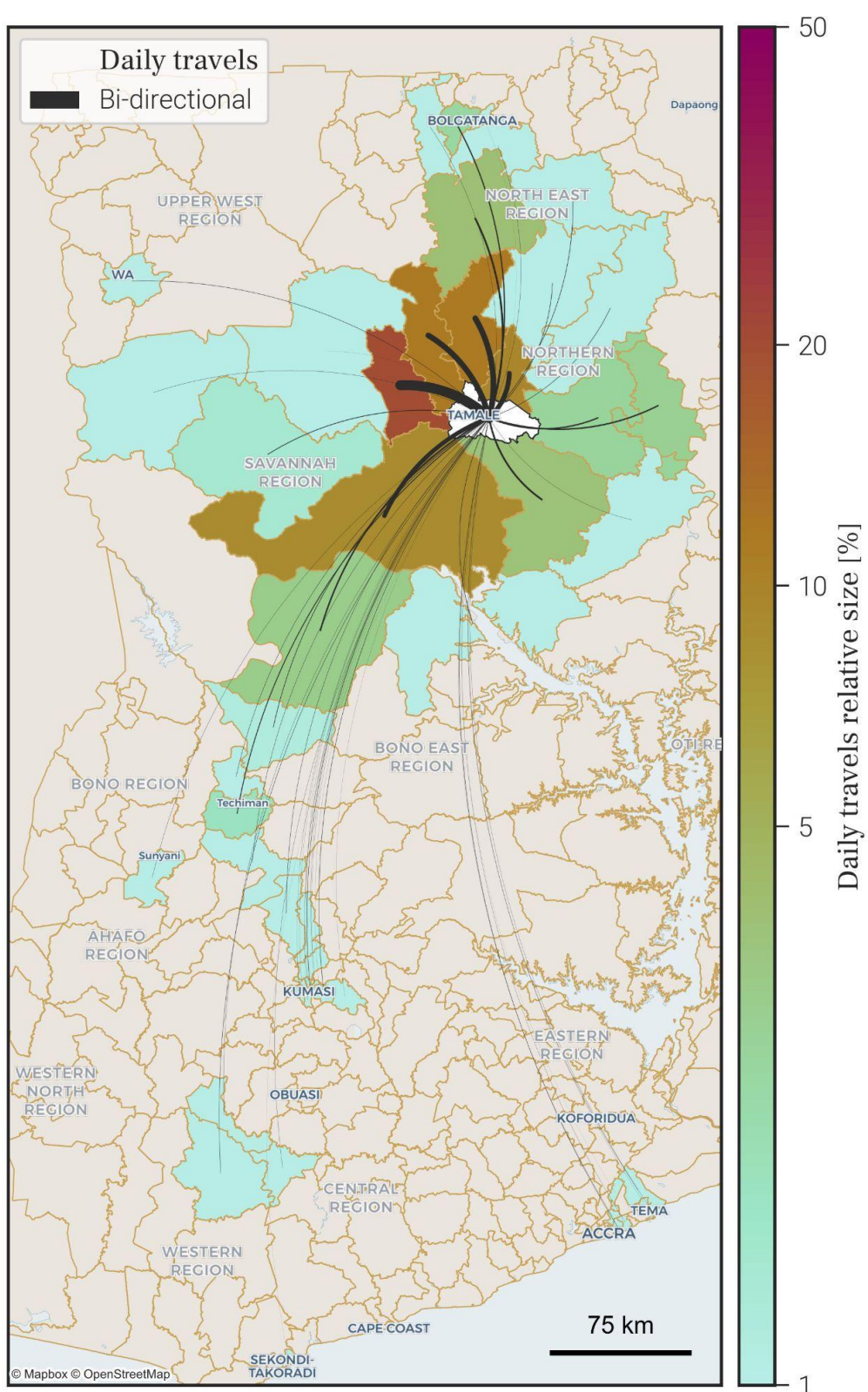


Figure 2.6.1 | Relative size of all daily travels to and from Tamale with other districts in Ghana, over the period 2020 to 2022.

2.6.2 | Daily time series of relative change in travellers for Tamale

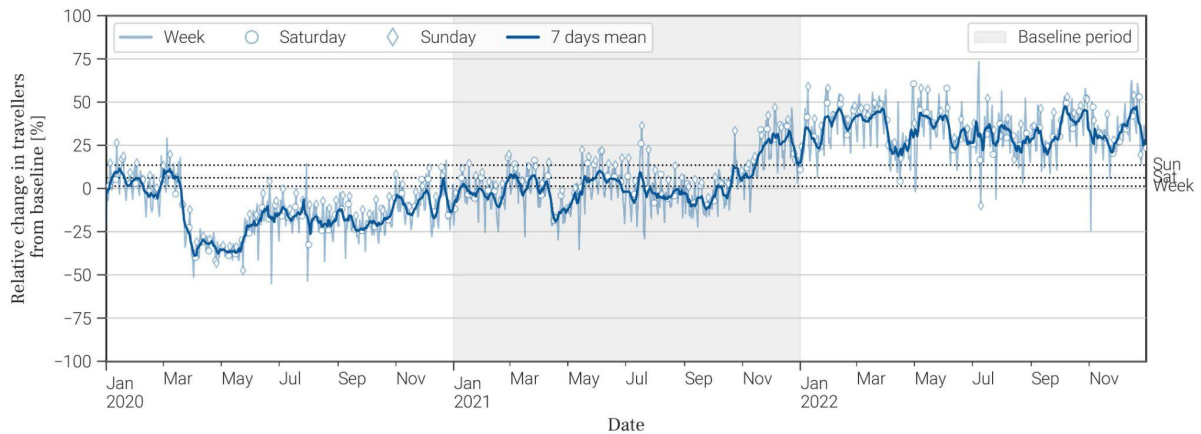


Figure 2.6.2 | Time series of relative change in travellers to and from Tamale with other districts in Ghana, over the period 2020 to 2022. Daily values are categorised into weekdays, Saturdays or Sundays, with associated medians over the period for each group.

2.6.3 | Abnormal values

No abnormal value

Annex

Data and data privacy

No personal data, such as an individual's identity, demographics, contacts or geolocated movements were made available to Flowminder, GSS or any other third party as part of this study. The CDR data was processed on a server installed behind Vodafone Ghana's firewall, and no personal data left the operator's premises. The data is fully anonymised. All of the analytical results are aggregated (for example, subscriber density in a given municipality). This approach complies with the European Union's General Data Protection Regulation (EU GDPR 2016/679).

Data considerations

The estimates shown are our best assessment of movements from non-traditional data (anonymised Call Detail Records from a mobile network operator). However, there are a number of uncertainties. The information should be interpreted together with other available evidence.

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