Russian Air/Drone Strikes on Ukraine

EDA Analysis (2022-2025)

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Research Overview

Research Questions

1. How has the **frequency** of air/drone strikes changed over time?
2. What is the **trend of fatalities** from these strikes?
3. Which regions are most heavily targeted?
4. What proportion of strikes target civilians/civilian infrastructure?
5. **Spatial Evolution**: How has the geographic focus of strikes shifted across years?

Data Source

ACLED (Armed Conflict Location & Event Data Project)

Methodology

- Exploratory Data Analysis (EDA)
- Time series analysis
- Geospatial mapping
- Statistical aggregation

Dataset Overview

Metric	Value
Total Strikes	4,447
Total Fatalities	8,982
Time Period	Feb 24, 2022 - Feb 13, 2025 (1,085 days)
Unique Locations	815
Regions Affected	23
Average Fatalities per Strike	2.02
Median Fatalities per Strike	1.00
Maximum Fatalities (Single Strike)	300

Key Insight: Over 3 years of conflict, Russian forces have conducted an average of **4.1 strikes per day**, resulting in an average of **8.3 fatalities per day**.

Yearly Breakdown

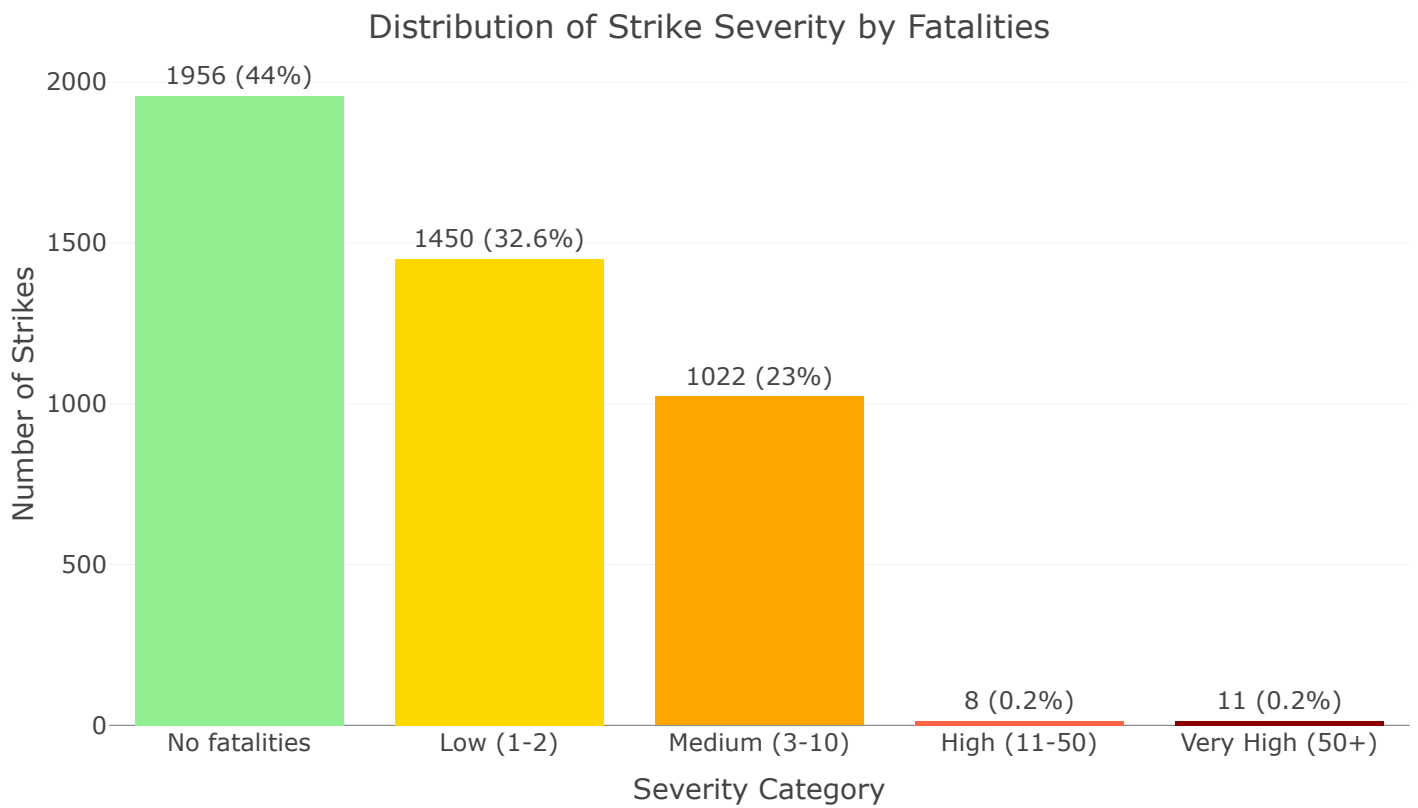
Year	Total Strikes	Total Fatalities	Avg Fatalities/Strike	Days in Period	Strikes per Day
2022	1042	3039	2.92	221	4.71
2023	1503	2887	1.92	280	5.37
2024	1670	2794	1.67	312	5.35
2025	232	262	1.13	41	5.66

Observation:

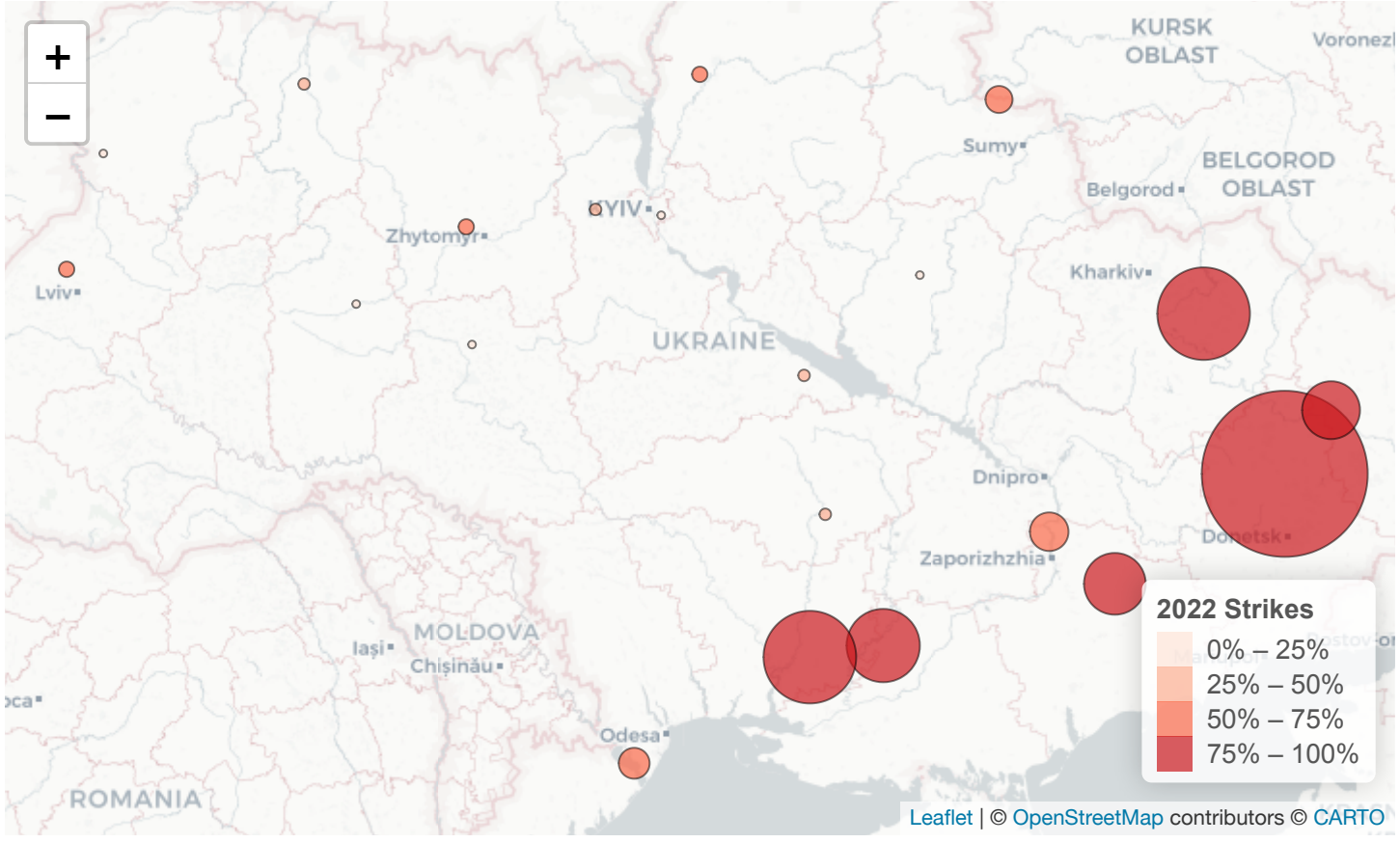
- Strike frequency **increased** from 2022 to 2024 (despite 2025 being partial year)
- Fatality rate per strike has **decreased** over time
- 2022 had highest average fatalities per strike (2.92)

Strike Frequency Over Time

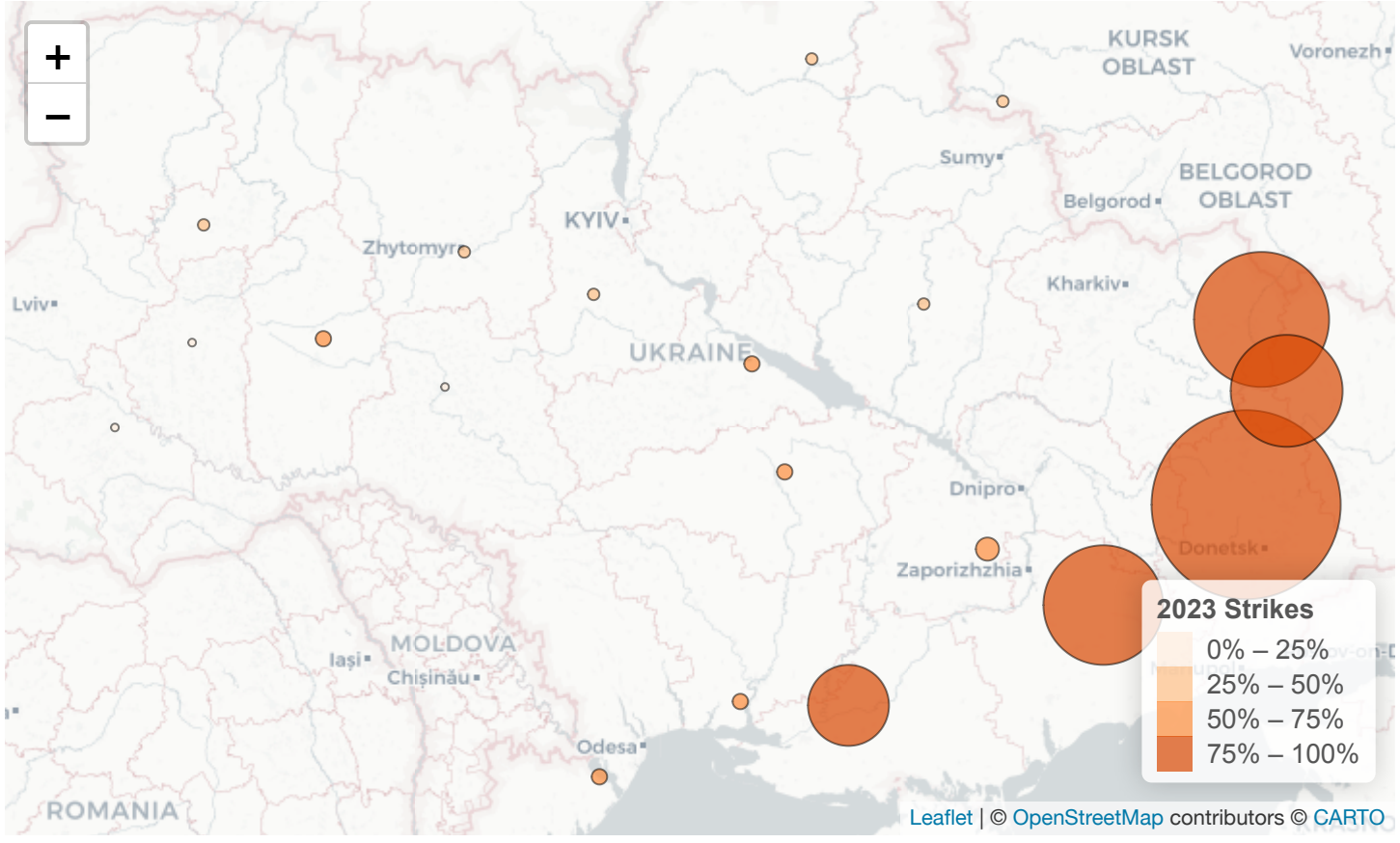
Distribution of Fatalities



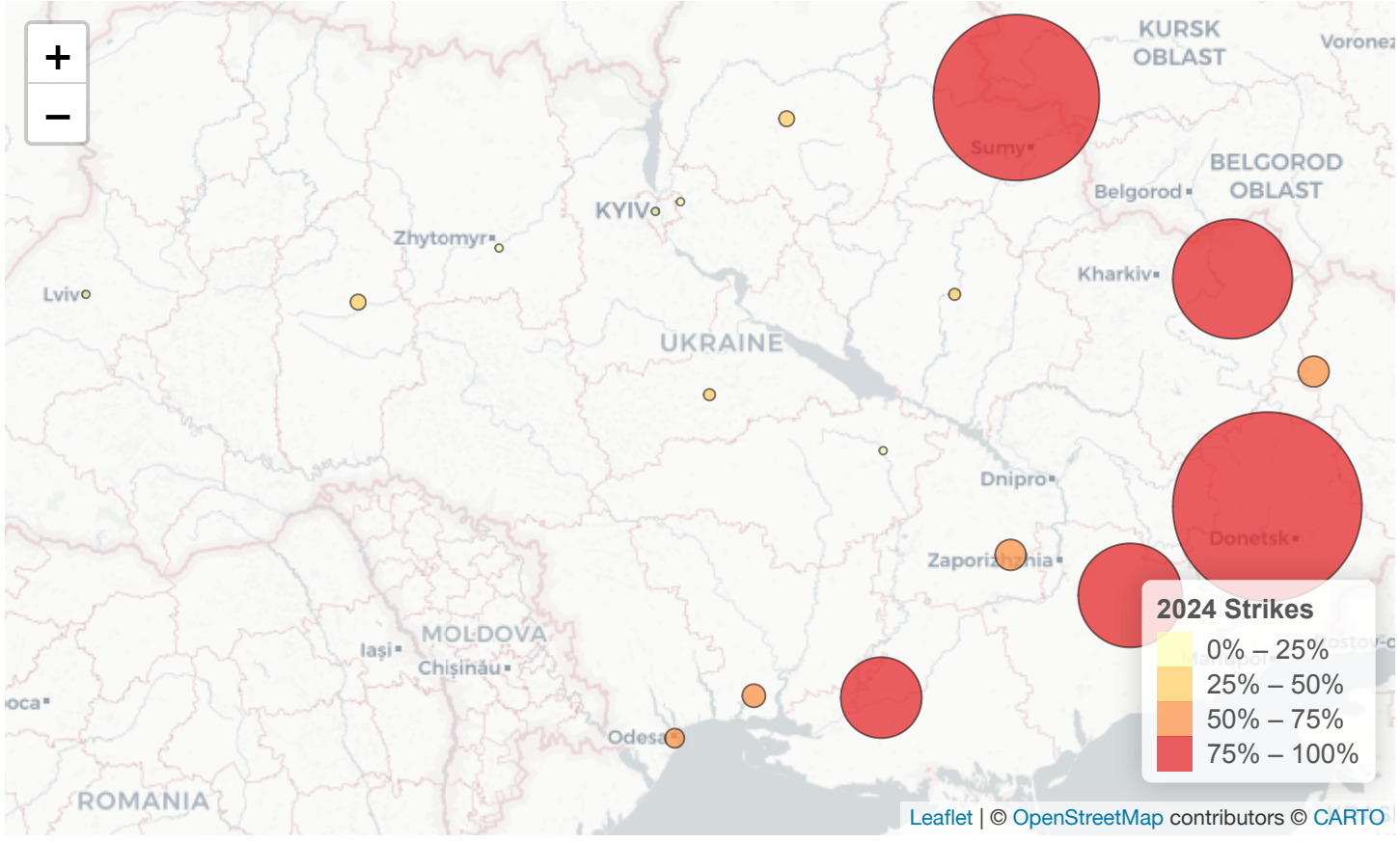
2022: Early War Period



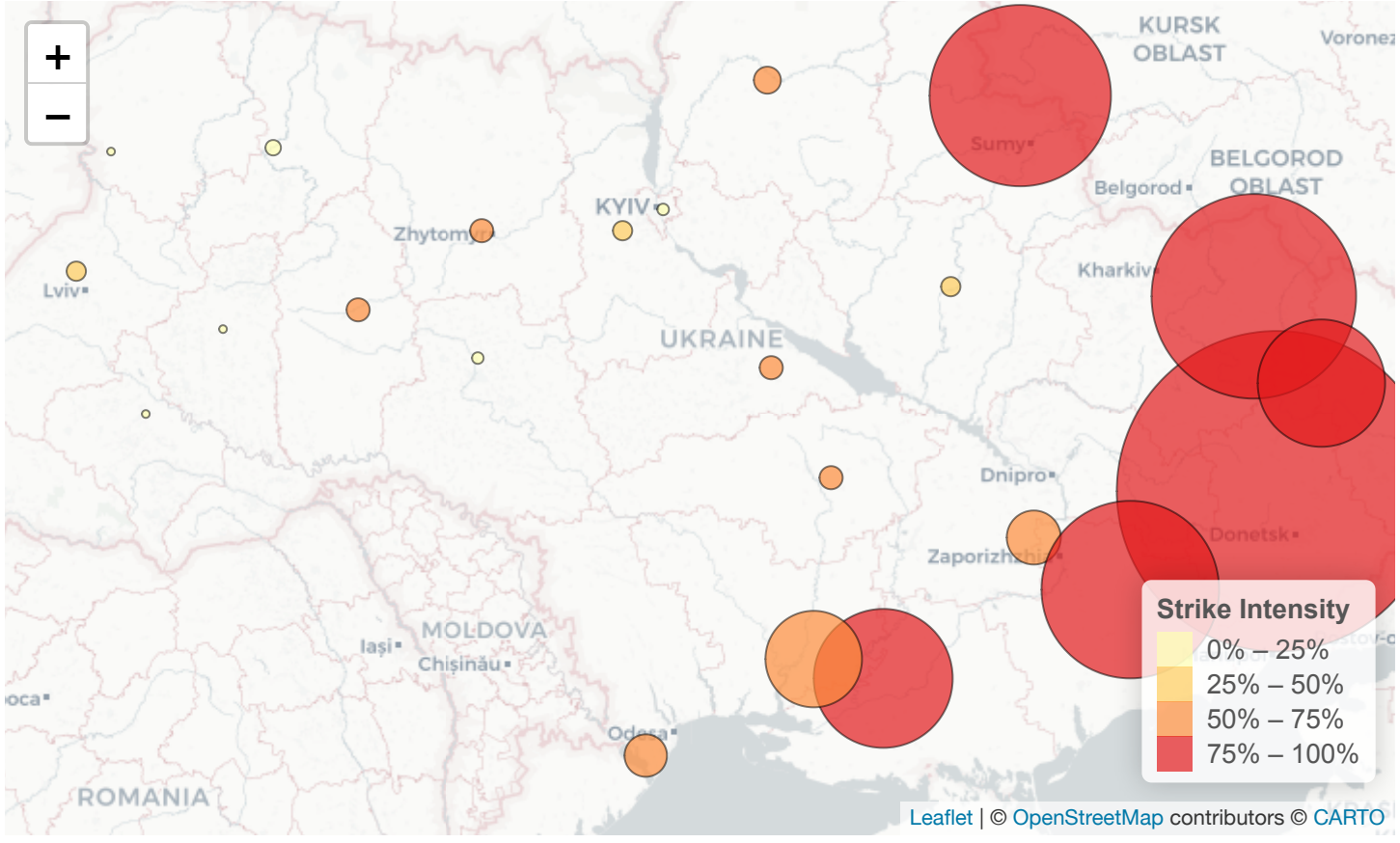
2023: Sustained Campaign



2024: Intensification

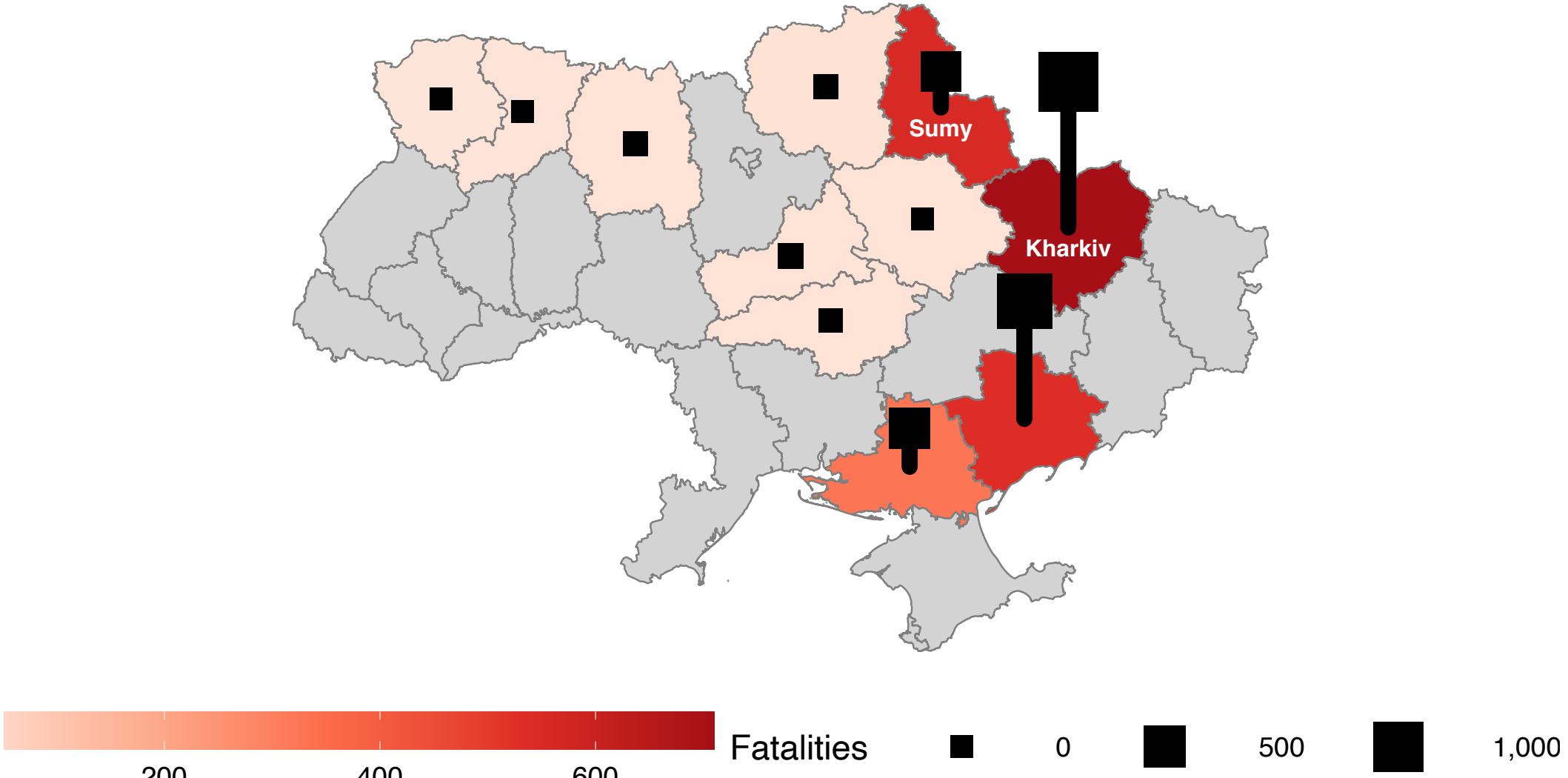


Geographic Heatmap: All Years Combined



Russian Air/Drone Strikes on Ukraine by Oblast

Red intensity: strike frequency | Black bars: fatality severity



Civilian Targeting Overview

Strikes Explicitly Involving Civilians (actor2)	139
Percentage of All Strikes	3.13%
Total Fatalities (Explicit Civilian Strikes)	605
Avg Fatalities per Civilian Strike	4.35
Strikes Mentioning Civilian Infrastructure (notes)	272
Percentage of All Strikes	6.12%
Total Fatalities (Civilian Infrastructure)	816
Avg Fatalities (Civilian Infrastructure)	3.00

Key Finding: Strikes explicitly involving civilians or civilian infrastructure have **significantly higher fatality rates** (3.00-4.35) compared to the overall average (2.02).

Civilian Impact by Year

year	Total Strikes	Total Fatalities	Civilian-Related Strikes	Fatalities	% Civilian-Related
2022	1042	3039	119	544	11.4
2023	1503	2887	55	65	3.7
2024	1670	2794	84	186	5.0
2025	232	262	14	21	6.0

Trend: Civilian-related strikes as a percentage of total strikes varied from 5.0% (2024) to 11.4% (2022), with the early war period showing higher rates.

Deadliest Strikes

Date	Region	Location	Fatalities
May 13, 2022	Kharkiv	Kharkiv	300
Jun 29, 2022	Donetsk	Avdiivka	250
Jun 11, 2023	Zaporizhia	Novodanylivka	250
Jul 26, 2022	Mykolaiv	Mykolaiv	200
Oct 02, 2022	Donetsk	Yampolivka	200
Aug 26, 2022	Mykolaiv	Kvitneve	160
Jul 07, 2022	Donetsk	Kramatorsk	151
Sep 27, 2022	Zaporizhia	Zaporizhia	150
Jul 01, 2022	Donetsk	Bakhmut	120
May 06, 2022	Kharkiv	Bohodukhiv	93

Catastrophic Events: The deadliest single strike resulted in 300 fatalities. The top 10 strikes account for **13.7%** of all fatalities across the entire conflict period.

Limitations and Considerations

Data Limitations

- **Reporting Bias**: Events in contested areas may be underreported
- **Fatality Verification**: Difficult to verify exact casualty figures in active war zones
- **Civilian Classification**: Not all civilian impacts may be explicitly flagged in data
- **Geographic Precision**: 82.7% of strikes coded at city/town level (precision = 2)

Implications for stakeholders

The intended stakeholders for this project are:

- Governments and military leadership : such research will allow them to understand whether their past and current strategies seem to be effective in terms of preserving the lives of their personnel, and if there is a necessity to change said strategy.
- Ukrainian taxpayers: their money is going towards military expenditure, and it is the government's responsibility to be using their money effectively and responsibly.
- Taxpayers of the countries supporting Ukraine financially: it is important to understand whether their money is spent effectively to help Ukraine preserve itself, or pressure the Ukrainian government if that is not the case.
- This analysis provides quantitative evidence of the air campaign's scale and impact, supporting humanitarian response planning, defense strategy, and documentation of the conflict for future accountability mechanisms.

Ethical, Legal, and Societal Implications

- The ethical, legal, and societal implications for this project are important in nature, as it is focusing on the preservation of human life, which is considered to be the most important quality of any living being.
- If this research deems to produce significant results- and we can understand which regions/cities/areas the adversary is targeting- it might contribute to the efforts of preserving human lives by investing in the defense technology locally or relocating the civilian populations that are in danger the most.

References and Data Sources

Primary Data Source & References

ACLED (Armed Conflict Location & Event Data Project)

- Website: https://acleddata.com/
- Coverage: Real-time conflict event data across 200+ countries
- Methodology: Multi-source verification with geolocation
- Citation: Raleigh, C., Linke, A., Hegre, H., & Karlsen, J. (2010). Introducing ACLED: An Armed Conflict Location and Event Dataset. *Journal of Peace Research*, 47(5), 651-660.

Analytical Tools

R, **Python**,**xaringan**, **Leaflet**, **Plotly**

This research uses publicly available conflict data.

Thank You

Questions?