

The background of the slide is a large, stylized, black and white illustration of the University of Vienna seal. The seal is circular and features a central figure, likely the Virgin Mary, wearing a crown and holding a child. The figure is surrounded by a decorative border with the Latin text "VERSI" on the left and "TAT LUDOVIC" on the right. The seal is set against a dark blue background.

## Applying Satellite Imagery in Nowcasting

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# Outline

- Main Findings
- Idea and Background
- Data
- Results
- Discussion
- Summary
- Questions

# Main Findings

- very-high resolution satellite imagery can be used in Nowcasting
- detected vehicles as measure of economic activity
- Strong suggested increase in economic activity after Russian withdrawal from Kyiv area
- Further validation and research needed

# Idea

- "The Warcast Index: nowcasting economic activity without official data during the Ukraine war in 2022" – Constantinescu, Kappner and Szumilo (2024)
- Mobility, toll and traffic data in Nowcasting literature
- Coincidence of data availability



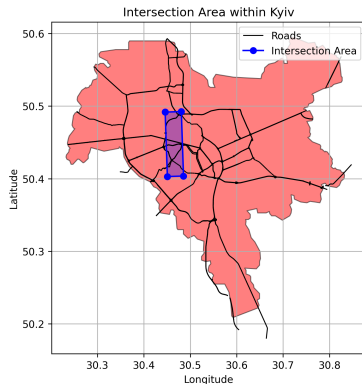
# Background

- Li, Xi, and Deren Li (2014): "Can Night-Time Light Images Play a Role in Evaluating the Syrian Crisis?". *International Journal of Remote Sensing* 35 (18): 6648–6661.
- Askitas, Nikolaos and Klaus F. Zimmermann (2013): "Nowcasting Business Cycles Using Toll Data". *Journal of Forecasting* 32: 299-306.

# Data - Satellite Images

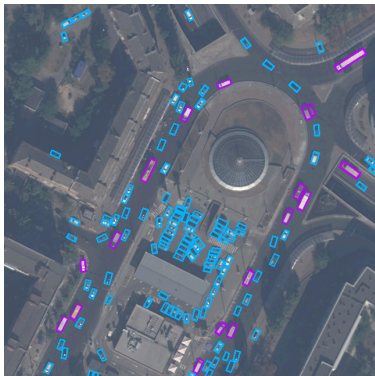
- RGB Optical Imagery from Pleiades Neo Satellite
- 30cm/pixel Resolution
- 2022-03-25, 2022-04-15, 2023-09-28
- $24\text{km}^2$

**Figure:** Intersection Area



# Data - Vehicle Detection I

**Figure:** Sevastopolska Square - 2023-09-28



**Table:** Recall, Precision and Accuracy

Timestamp	Recall	Precision	Accuracy
2022-03-25 08:53	0,66	0,97	0,65
2022-04-15 08:57	0,82	0,99	0,81
2023-09-28 09:08	0,63	0,98	0,62

**Notes:** Reported for cars only. Large Vehicles with better Recall and Accuracy.

# Data - Vehicle Detection II

**Figure:** 2022-03-25



**Figure:** 2022-04-15



**Figure:** 2023-09-28



# Data - Resulting Dataset

**Table:** Numbers of Cars and Large Vehicles in Intersection Area

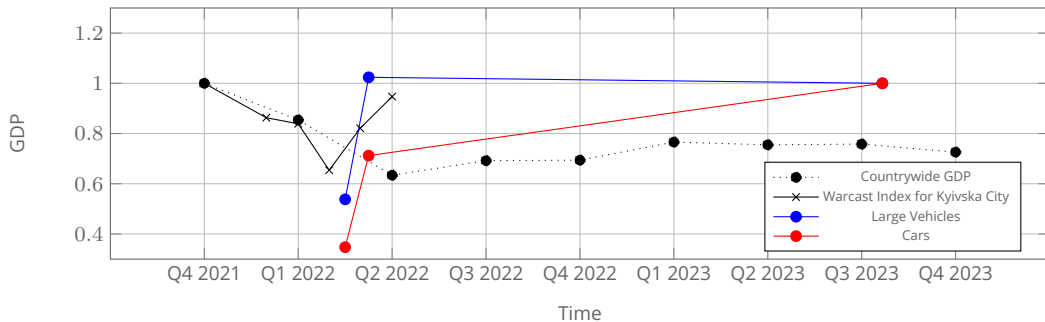
Timestamp	Cars	Large Vehicles
2022-03-25 08:53	6330	1037
2022-04-15 08:57	16296	2138
2023-09-28 09:08	18295	1719
Sum	40921	4894

**Table:** Acc. Corrected Numbers of Cars and Large Vehicles in Intersection Area

Timestamp	Cars	Large Vehicles
2022-03-25 08:53	9738	1234
2022-04-15 08:57	20117	2349
2023-09-28 09:08	29508	2292

# Results

**Figure:** GDP, Detected Vehicles and Nightlights Values from Q4 2021 to Q4 2023



**Notes:** Cars and large vehicle values are normalized to 1 at 2023-09-28.

# Discussion

- Economic Indicator
- Urban Area Specifics
- Heterogeneity
- Commuting Behavior
- Martial Law
- Measurement Errors and other Shortcomings

# Application

- Clouds
- Access
- Costs



# Summary

- very-high resolution satellite imagery can be used in Nowcasting
- detected vehicles as measure of economic activity
- Strong suggested increase in economic activity after Russian withdrawal from Kyiv area
- Further data and research needed

Thank you!

# Vehicle Detection Measures

**Table:** Descriptive Data of Satellite Imagery

Satellite	Resolution	Timestamp	Off-Nadir	Covered Area	Sun Elevation
PHR1B	50 cm/px	2019-12-06 09:00	15,39°	52,78 km <sup>2</sup>	16,39°
PHR1A	50 cm/px	2022-02-04 09:16	10,29°	46,18 km <sup>2</sup>	22,36°
PNEO4	30 cm/px	2022-03-25 08:53	21,94°	31,81 km <sup>2</sup>	38,57°
PNEO4	30 cm/px	2022-04-15 08:57	13,97°	26,02 km <sup>2</sup>	46,95°
PHR1A	50 cm/px	2023-02-10 09:11	19,70°	52,78 km <sup>2</sup>	23,89°
PNEO4	30 cm/px	2023-09-28 09:08	5,01°	37,91 km <sup>2</sup>	37,42°

# Vehicle Detection Measures

**Table:** Recall, Precision and Accuracy for Satellite Imagery

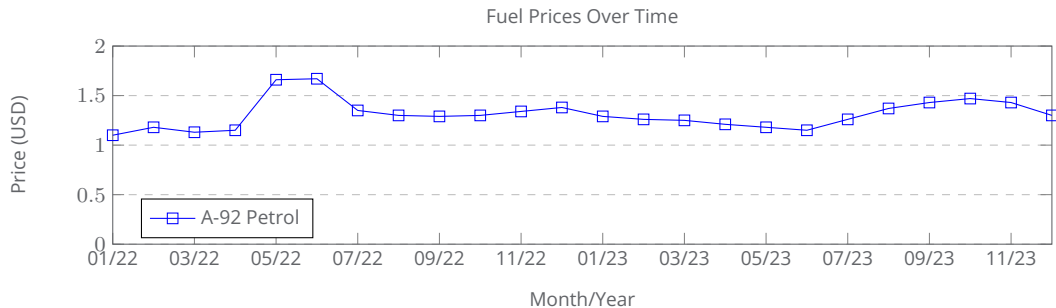
Satellite	Timestamp	Recall	Precision	Accuracy	% in Shadows	Cars	Large Vehicles
PHR1B	2019-12-06 09:00	-	-	-	-	? / 1	? / 81
PHR1A	2022-02-04 09:16	-	-	-	-	? / 88	? / 10
PNEO4	2022-03-25 08:53	0,66 / 0,84	0,97 / 1	0,65 / 0,84	0,45 / 0	189 / 8050	67 / 1545
PNEO4	2022-04-15 08:57	0,82 / 0,95	0,99 / 0,95	0,81 / 0,91	0,47 / 0	205 / 16546	22 / 2211
PHR1A	2023-02-10 09:11	-	-	-	-	? / 50	? / 19
PNEO4	2023-09-28 09:08	0,63 / 0,76	0,98 / 0,97	0,62 / 0,75	0,68 / 0,41	390 / 27801	43 / 3238

**Notes:** Recall, Precision and Accuracy are reported Cars / Large Vehicles while Cars and Large Vehicles columns are reported sample count / full image count. "% in Shadows" refers to the share of non detected Cars and Large Vehicles that were in a shadow of a building.

**Source:** Own calculations.

# Vehicle Detection Measures

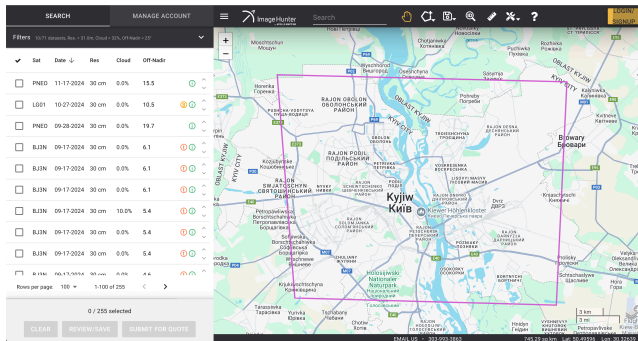
**Figure:** Fuel Prices from January 2022 to December 2023



**Notes:** Price for A-92 petrol from January 2022 to December 2023.

# Available Images

Figure: Available Images from Apollomapping



Source: <https://imagehunter.apollomapping.com/>