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Urban land cover mapping in coastal zone of Kaniv Reservoir

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Czech Republic, Brno, 26th - 29th June 2023
Recent terrestrial ecosystems LCLU changes and driving forces - challenges for RS and sustainable management

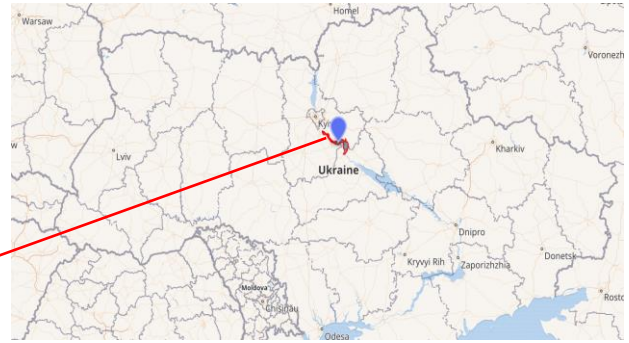
Global Change Research Institute, CAS
GOFC-GOLD and START, USA
NASA Goddard Space Flight Center
University of Maryland, Baltimore County
Charles University, Prague, Faculty of Science

Overview

- Introduction about Kaniv Reservoir
- Motivation and Study objectives
- Data and Methods used
- Results

Introduction

Kaniv Reservoir



49°55'34"N 31°28'46"E

Type: hydroelectric reservoir
Primary inflows: Dnieper River
Primary outflows: Dnieper River
Basin countries: Ukraine, Belarus, Russia

Normal water level: since 1976
Length: 123 km
Max. width: 8 km
Surface area: 675 km2
Average depth: 4 m
Surface elevation: 87 m

Objectives

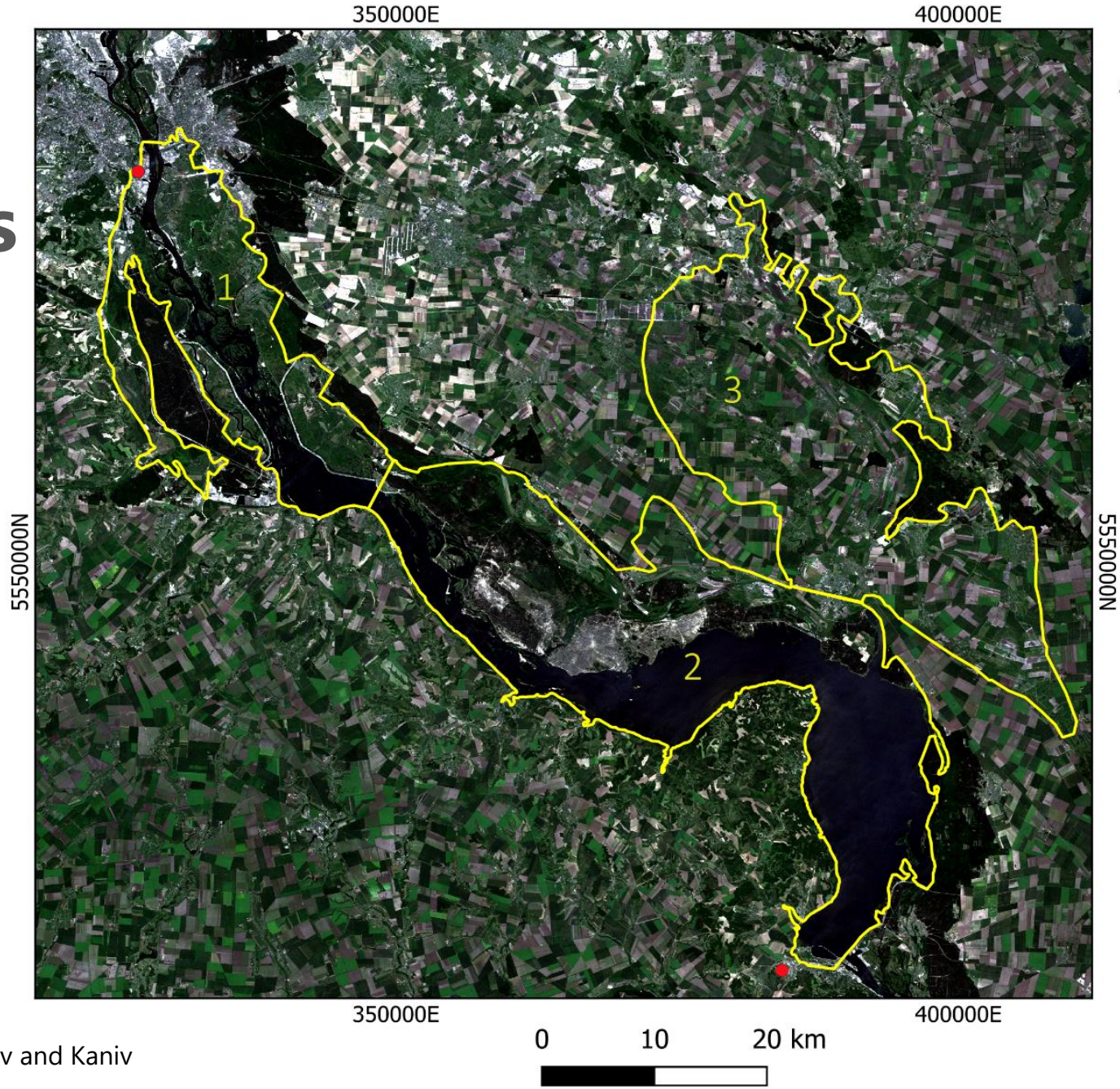
The study contributes to the Kaniv Reservoir research works and uses satellite data **to explore urban land cover changes** in the coastal zone of the Kaniv Reservoir throughout a **35–year** study period:

1/ to detect and quantify urban land cover changes using satellite Landsat data,

2/ to analyze land surface temperature (LST) trend in the coast zone of the reservoir within different study area zones.

Data and Methods

FRWL = 92.7 m
(Forced Retaining Water Level)

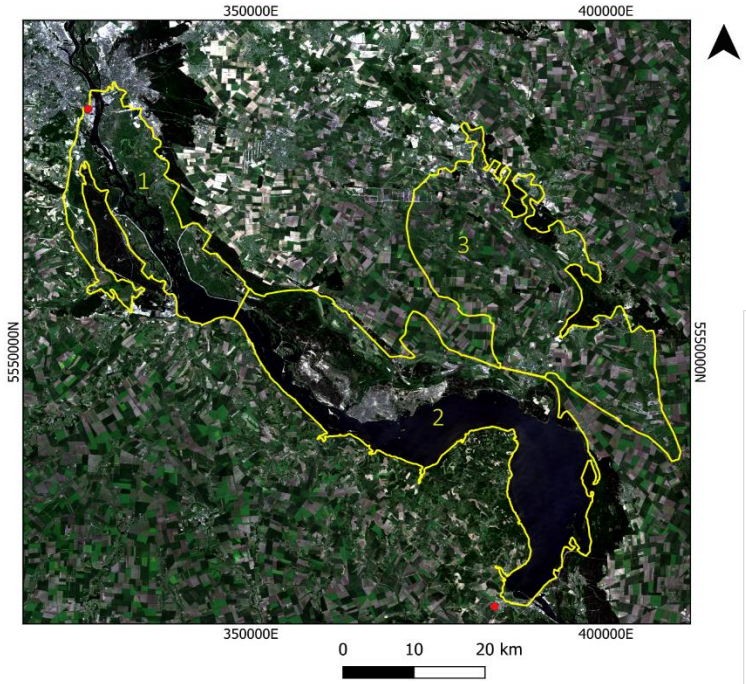


● Location of meteorological stations Kiev and Kaniv

Conditional zones for analysis

N	Description	% of water
1	Intensive construction and expansion of infrastructure	25
2	long-term disturbed soil and vegetation cover	50
3	plain intensive agriculture area	-

Data and Methods

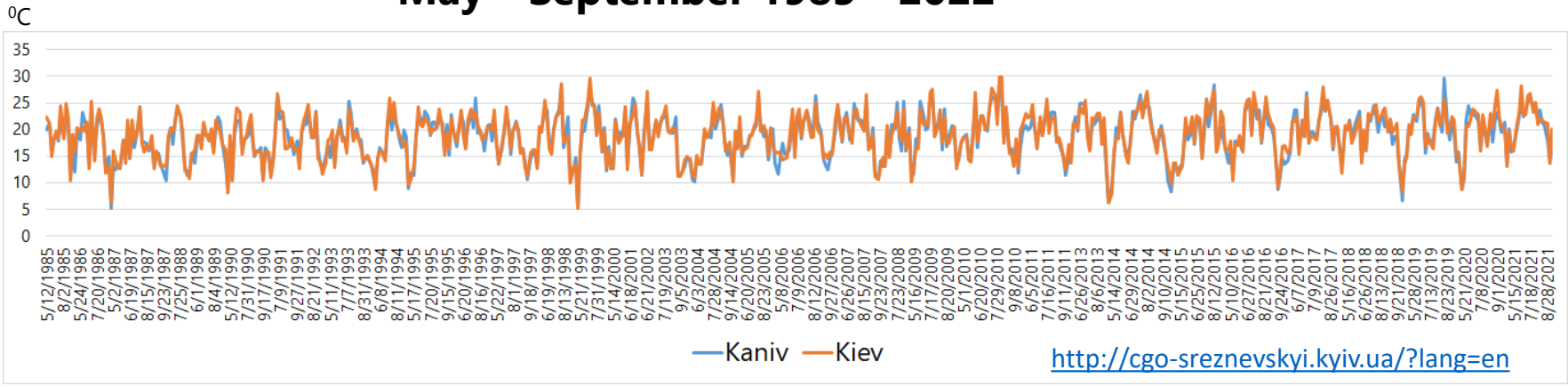


● Location of meteorological stations Kiev and Kaniv

Satellite Landsat imagery

Data	Date	Processing level	Source
Landsat-5	6.06.**1985**	Surface reflectance, L2A	https://earthexplorer.usgs.gov/
Landsat-7	7.06.**2000**		
Landsat-9	20.06.**2022**		

Average day air temperature May – September 1985 - 2022



http://cgo-sreznevskyi.kyiv.ua/?lang=en

Processing of satellite Landsat data

Landsat image

↓

Principal Component Analysis

↓

Masking of water

↓

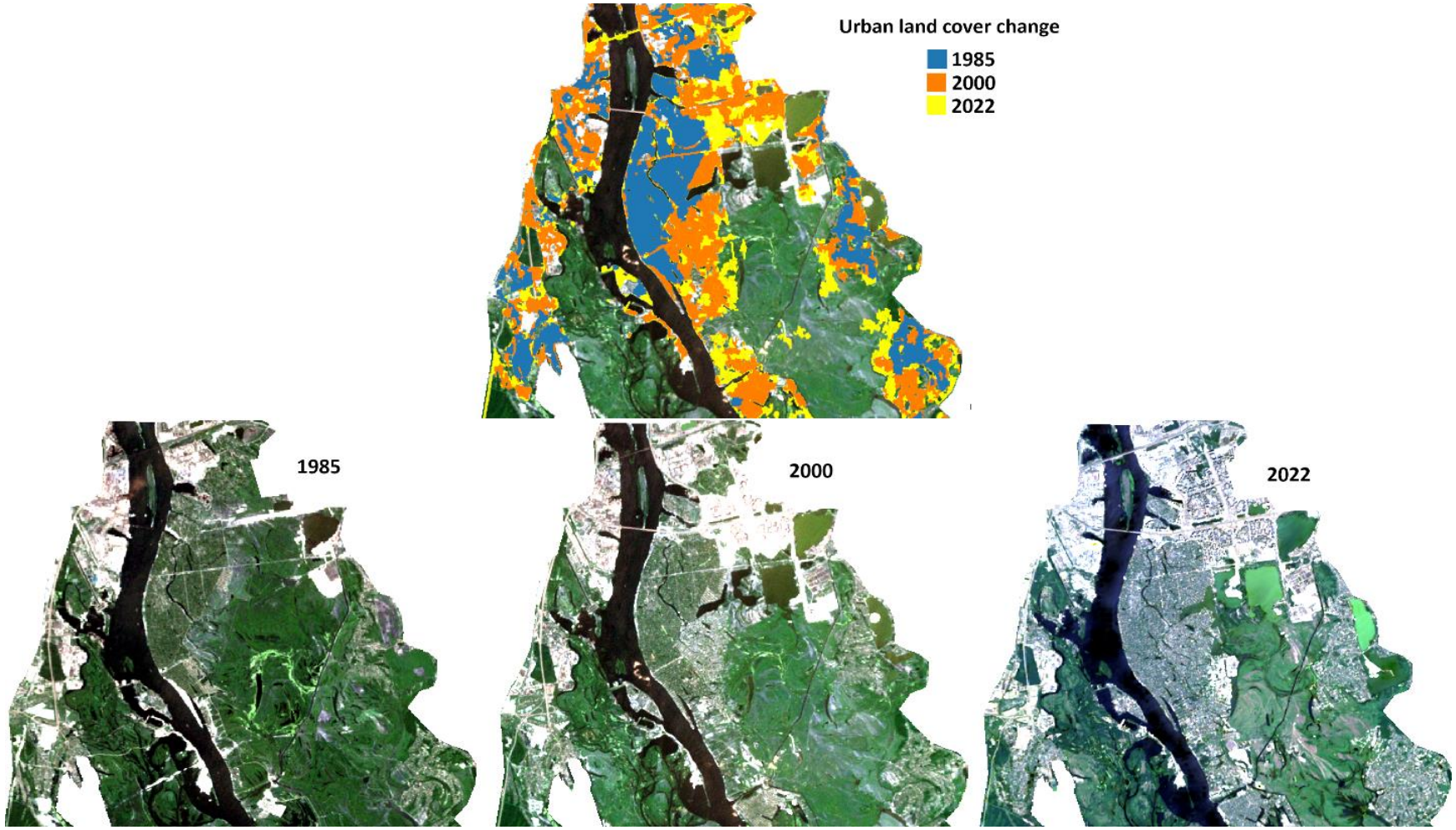
Image segmentation

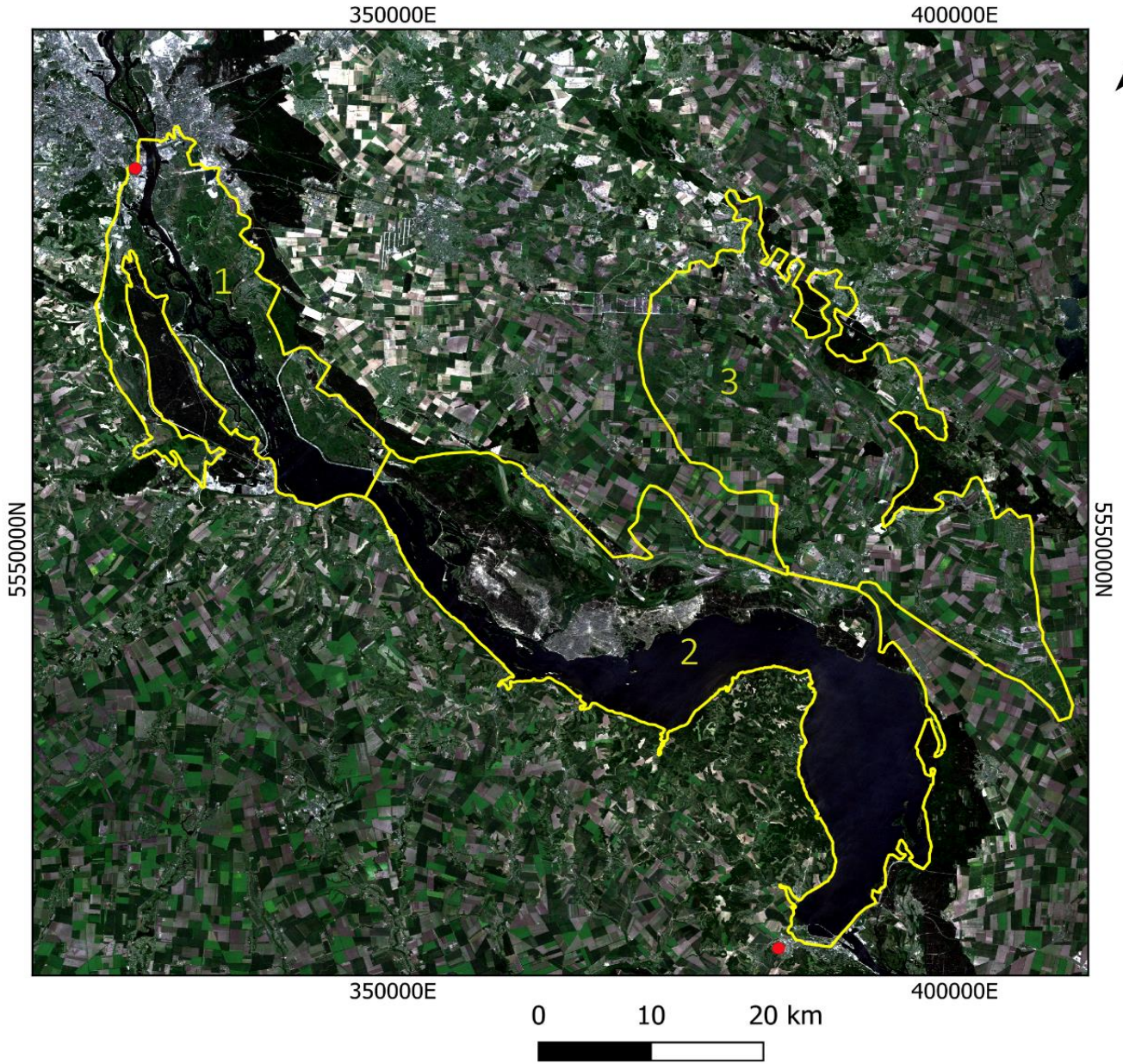
↓

Object-based classification

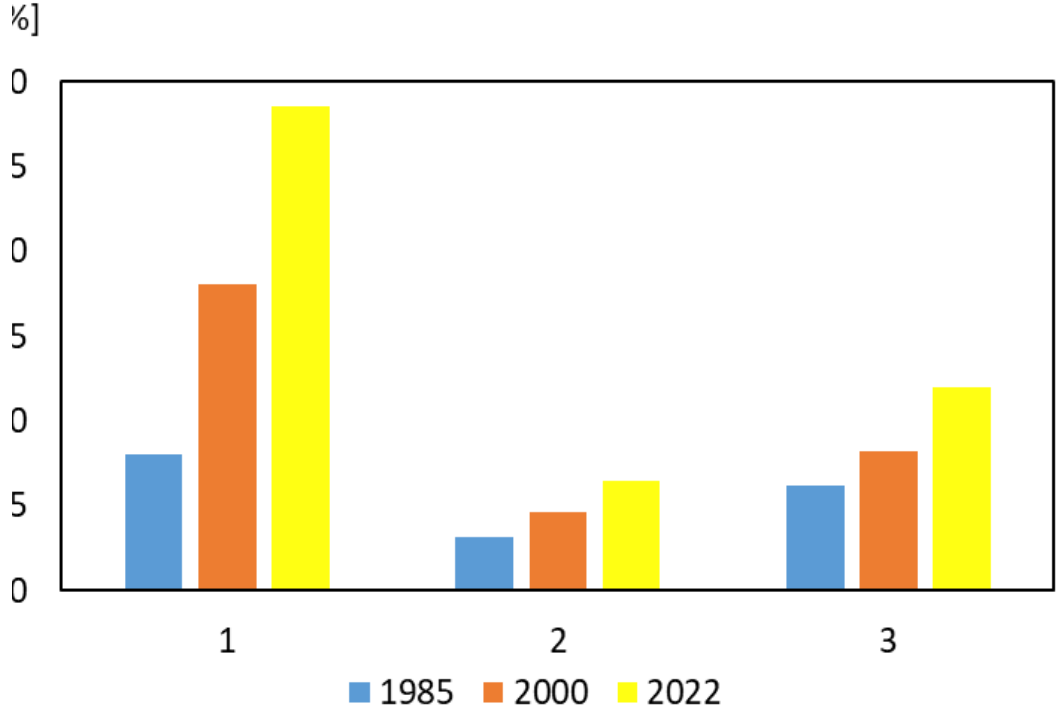
↓

Urban land cover layer





Changes of urban land cover in zones 1, 2, 3 of study area in 1985, 2000, and 2022

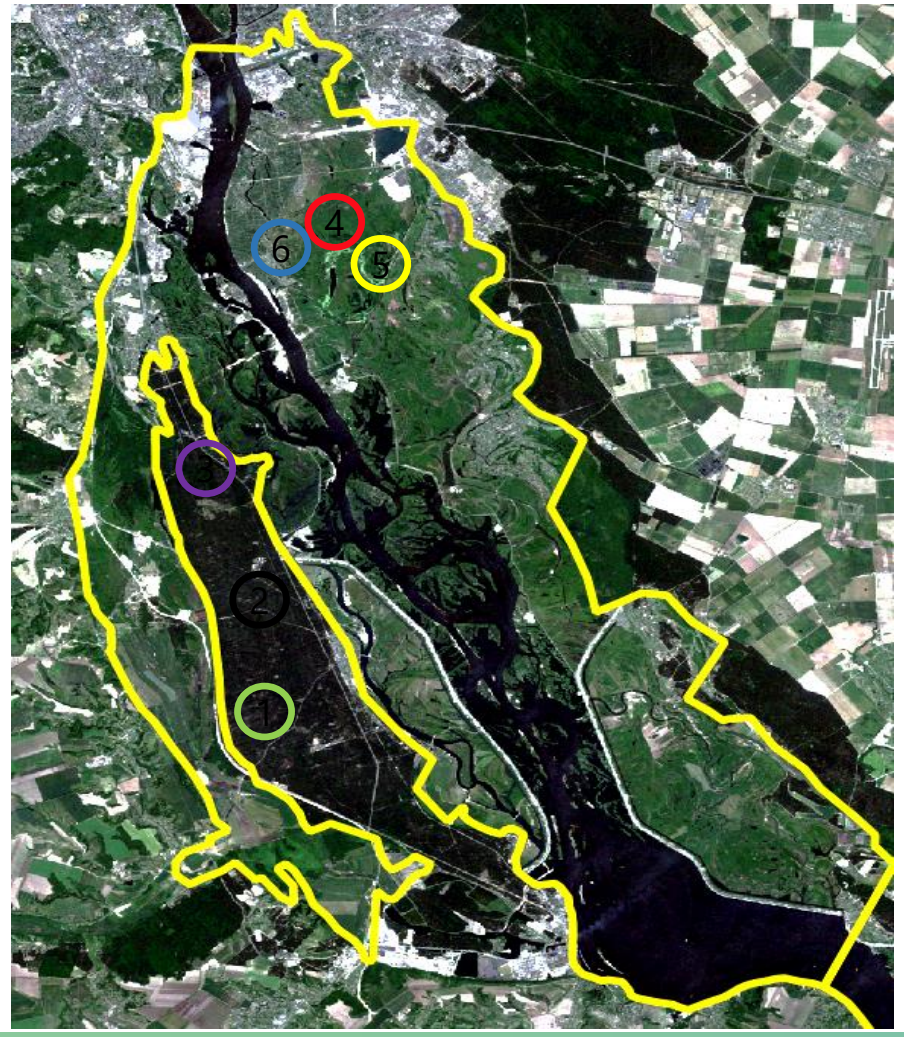


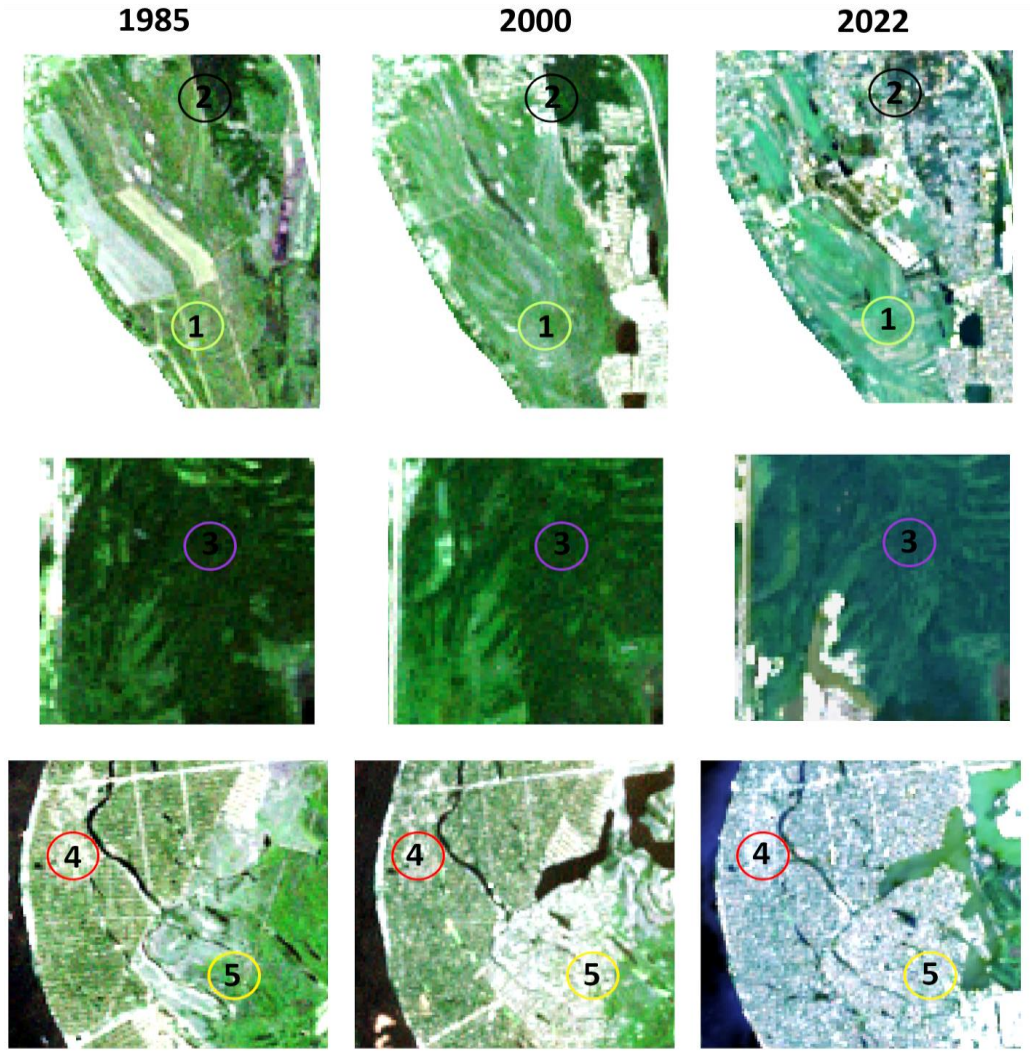
Analysis of Land Surface Temperature (LST)

- LST values were estimated using the Statistical Mono-Window algorithm (GEE code from Ermida et al. 2020)
- LST values were estimated for 3 zones and 6 small locations from zone 1
- LST values were estimated for vegetation period from May to September for the period of 35 years

Ermida, S., Soares, P., Mantas, V., Göttsche, F.-M., Trigo, I. 2020. Google Earth Engine Open-Source Code for Land Surface Temperature Estimation from the Landsat Series. Remote Sensing. 12. 1471. 10.3390/rs12091471.

Small locations in Zone_1



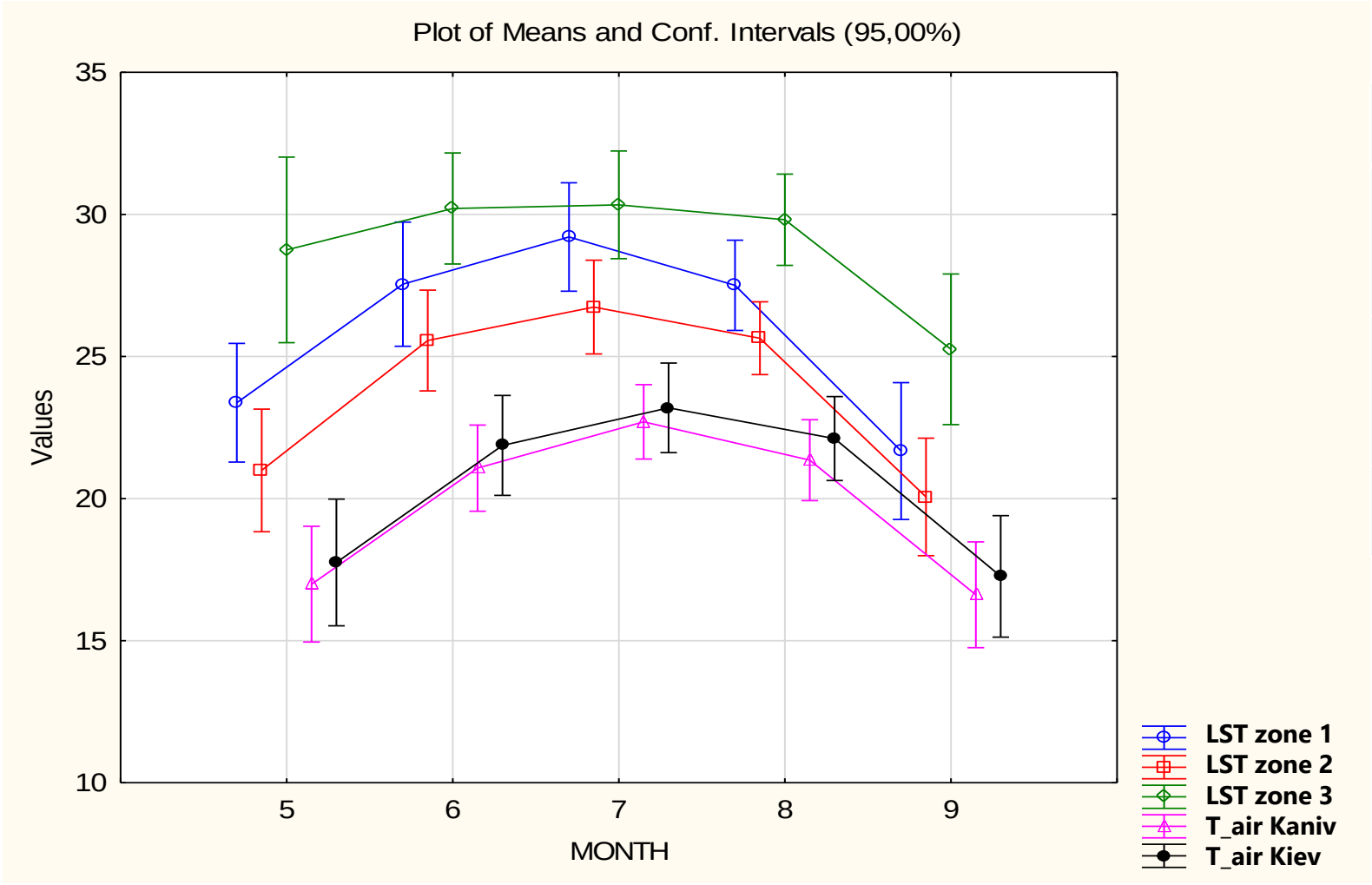


LULCC

	1985	2022
1	agriculture	agriculture
2	vegetation	urban
3	forest	forest
4	urban	urban
5	urban mix vegetation	urban
6	water	water

Mean Surface Temperature for 3 zones

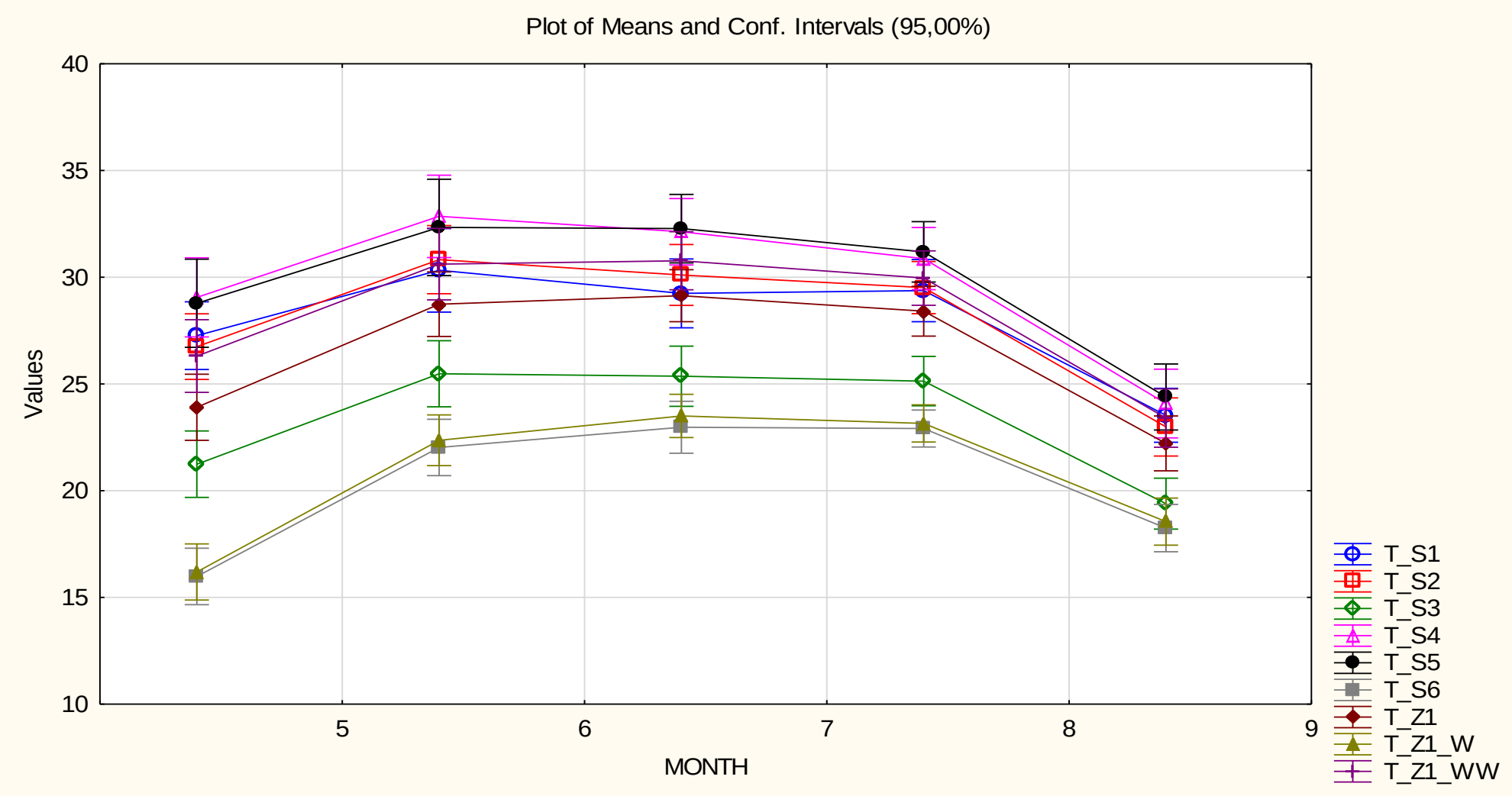
35 years MEAN temperature for May, June, July, August, and September



Conditional zones for analysis

N	Description	% of water
1	Intensive construction and expansion of infrastructure	25
2	long-term disturbed soil and vegetation cover	50
3	plain intensive agriculture area	-

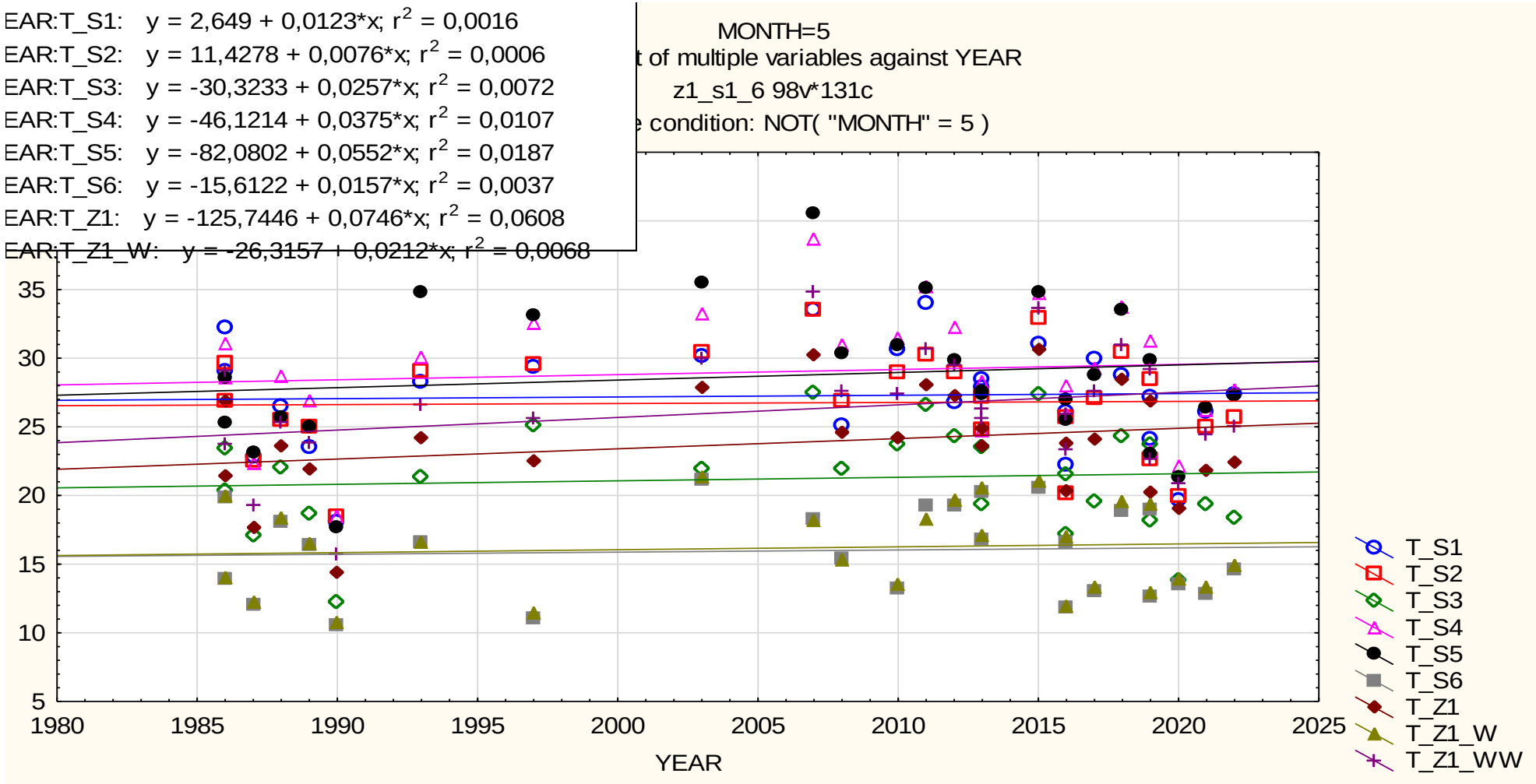
Mean Surface Temperature for 6 sites



LULCC

	1985	2022
1	agriculture	agriculture
2	vegetation	urban
3	forest	forest
4	urban	urban
5	urban mix vegetation	urban
6	water	water

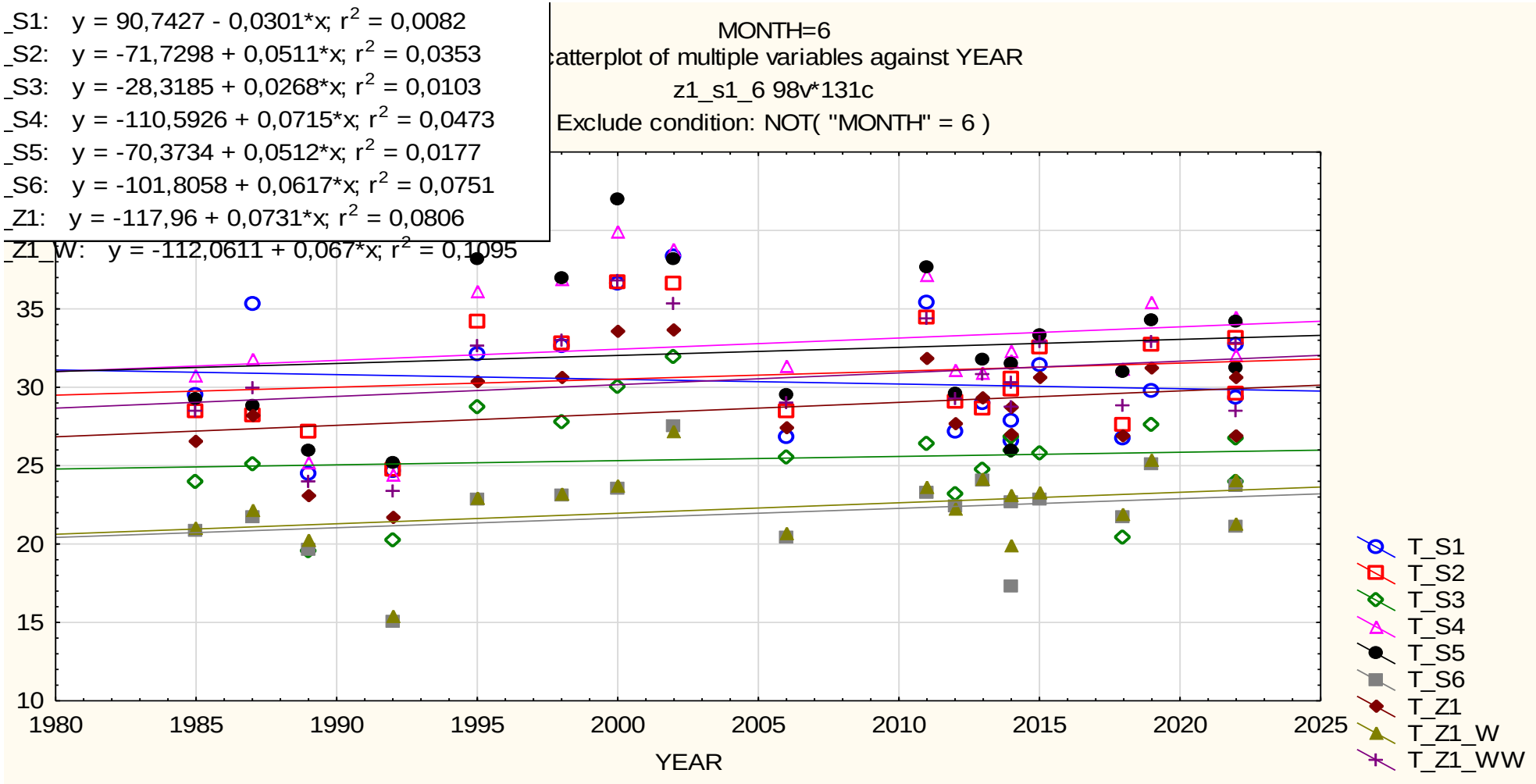
Surface Temperature trend for 35 years, MAY



LULCC

	1985	2022
1	agriculture	agriculture
2	vegetation	urban
3	forest	forest
4	urban	urban
5	urban mix vegetation	urban
6	water	water

Surface Temperature trend for 35 years, JUNE

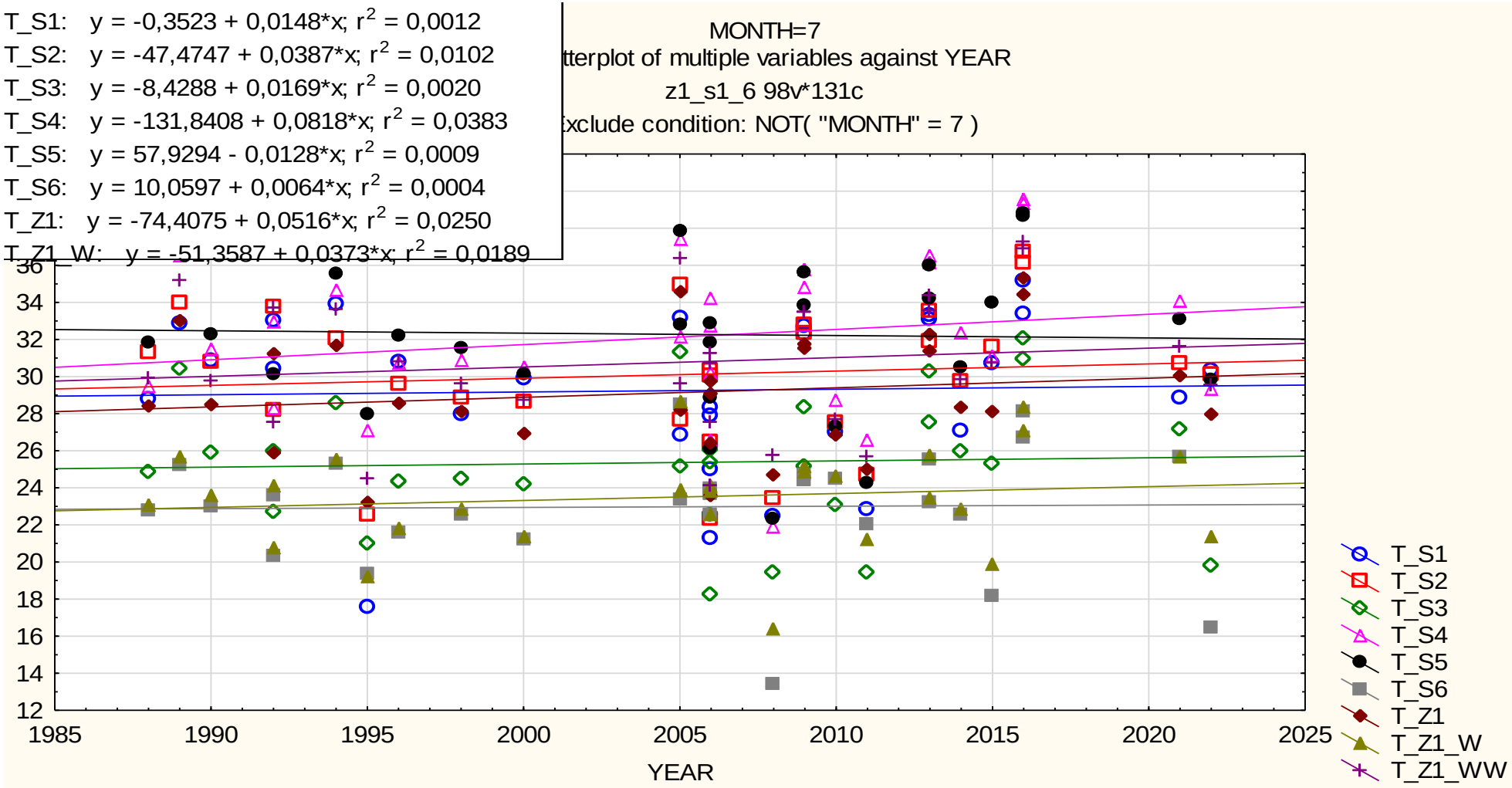


LULCC

	1985	2022
1	agriculture	agriculture
2	vegetation	urban
3	forest	forest
4	urban	urban
5	urban mix vegetation	urban
6	water	water

Surface Temperature trend for 35 years, JULY

T_S1: y = -0,3523 + 0,0148*x; r^2 = 0,0012
T_S2: y = -47,4747 + 0,0387*x; r^2 = 0,0102
T_S3: y = -8,4288 + 0,0169*x; r^2 = 0,0020
T_S4: y = -131,8408 + 0,0818*x; r^2 = 0,0383
T_S5: y = 57,9294 - 0,0128*x; r^2 = 0,0009
T_S6: y = 10,0597 + 0,0064*x; r^2 = 0,0004
T_Z1: y = -74,4075 + 0,0516*x; r^2 = 0,0250
T_Z1_W: y = -51,3587 + 0,0373*x; r^2 = 0,0189

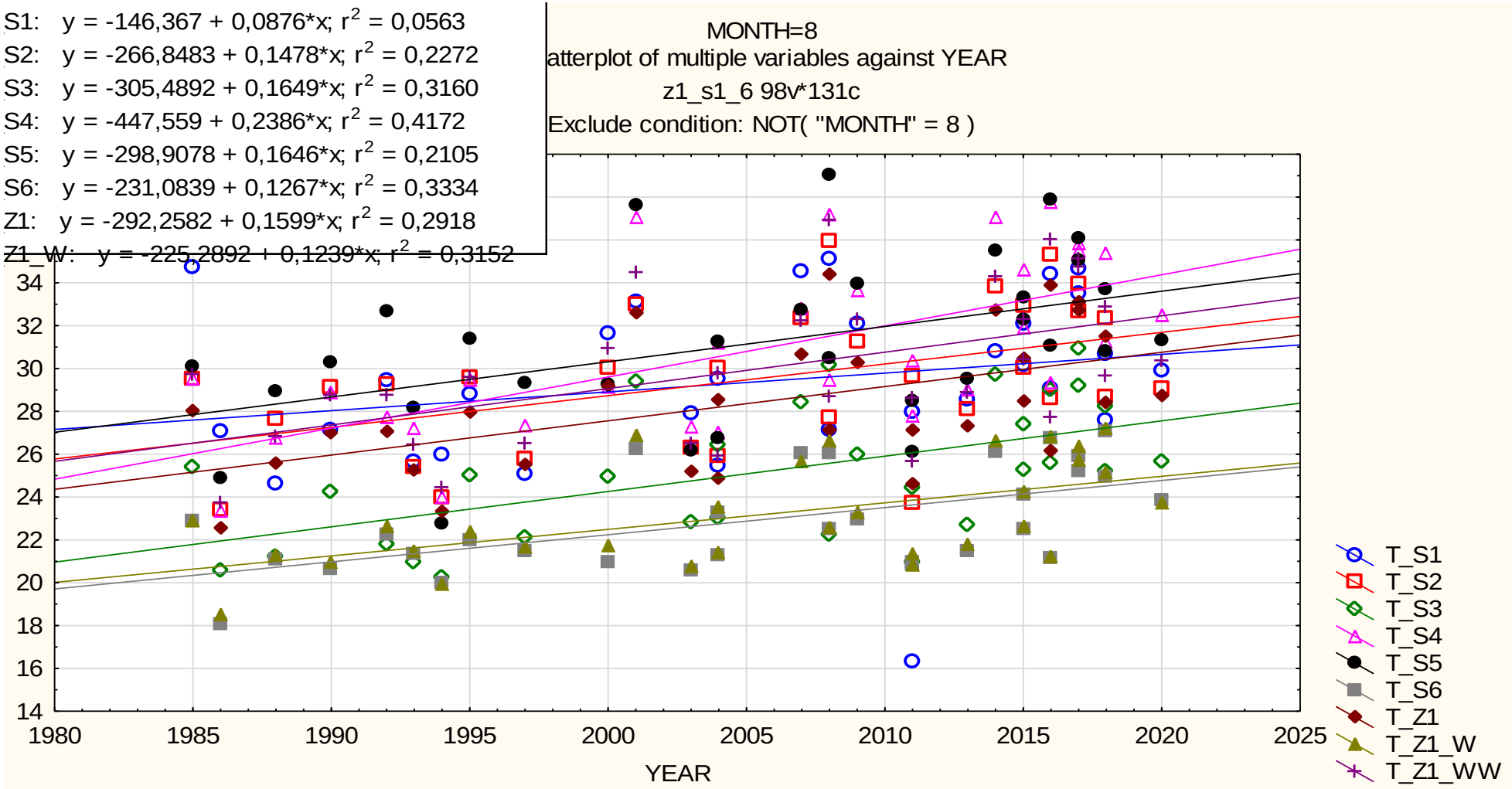


LULCC

	1985	2022
1	agriculture	agriculture
2	vegetation	urban
3	forest	forest
4	urban	urban
5	urban mix vegetation	urban
6	water	water

Surface Temperature trend for 35 years, AUGUST

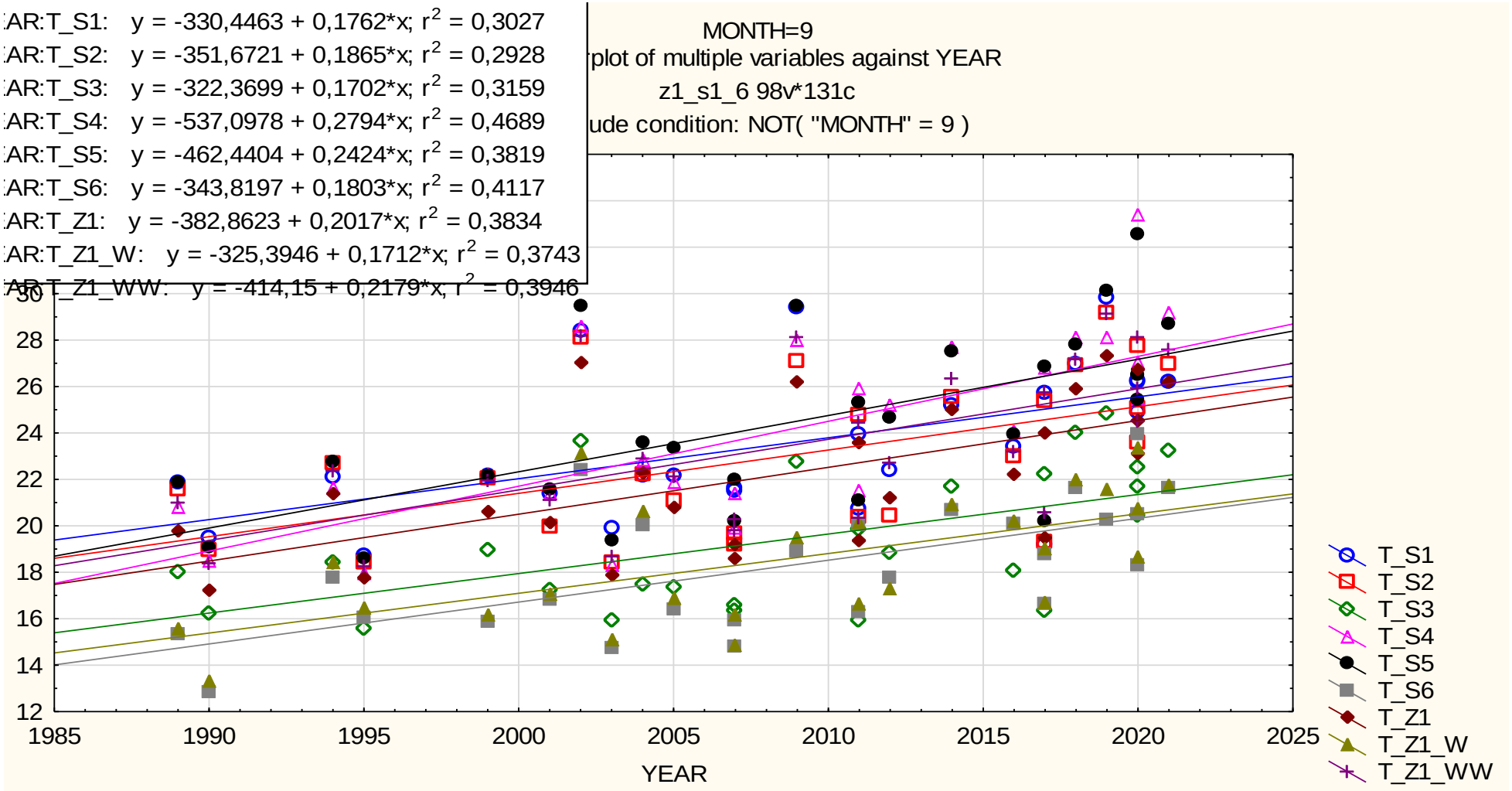
S1: y = -146,367 + 0,0876*x; r^2 = 0,0563
S2: y = -266,8483 + 0,1478*x; r^2 = 0,2272
S3: y = -305,4892 + 0,1649*x; r^2 = 0,3160
S4: y = -447,559 + 0,2386*x; r^2 = 0,4172
S5: y = -298,9078 + 0,1646*x; r^2 = 0,2105
S6: y = -231,0839 + 0,1267*x; r^2 = 0,3334
Z1: y = -292,2582 + 0,1599*x; r^2 = 0,2918
Z1_W: y = -225,2892 + 0,1239*x; r^2 = 0,3152



LULCC

	1985	2022
1	agriculture	agriculture
2	vegetation	urban
3	forest	forest
4	urban	urban
5	urban mix vegetation	urban
6	water	water

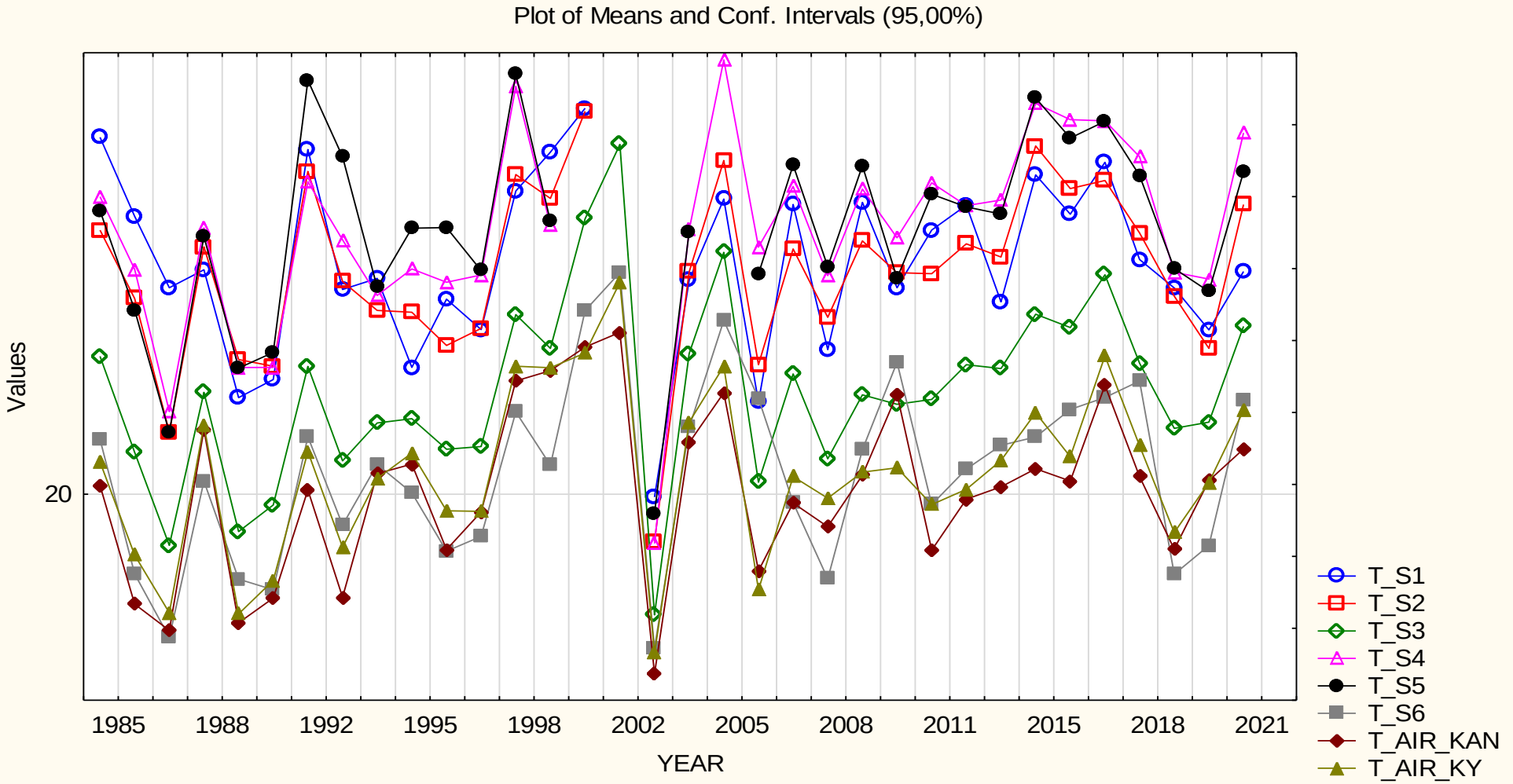
Surface Temperature trend for 35 years, SEPTEMBER



LULCC

	1985	2022
1	agriculture	agriculture
2	vegetation	urban
3	forest	forest
4	urban	urban
5	urban mix vegetation	urban
6	water	water

Surface Temperature trend for 35 years



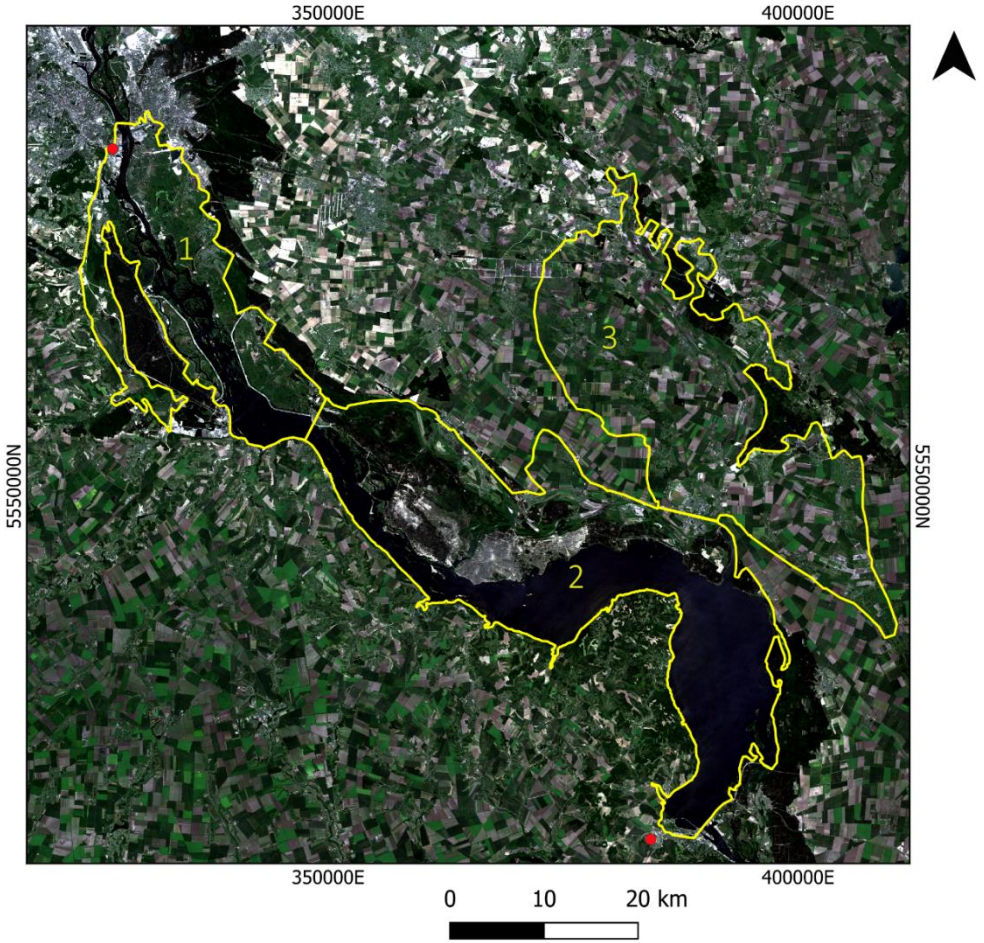
LULCC

	1985	2022
1	agriculture	agriculture
2	vegetation	urban
3	forest	forest
4	urban	urban
5	urban mix vegetation	urban
6	water	water

Conclusion

- The urban land cover has been increasing during the analyzed time period from 1985 to 2022
- The increase was uneven over time and different in each of three zones. Zone 1, which is closest to Kiev city, saw the maximum increase in urban area, with a growth rate of 3.6 times.
- There is a positive trend in surface temperature of 3 zones and 6 small locations throughout the entire study period (1985 - 2022).
- There is a statistical significant trend in surface temperature in August and September throughout the entire study period (1985 - 2022). The increase in surface temperature in August and September was approximately twice as higher as in other months.

Thank you for your attention!



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