Analysis of the dynamics of atmospheric air temperature in Mykolaiv

Patrusheva Larysa
Niepieina Hanna
Tetiana Uchen

General characteristics of the research

The region *is the Black Sea steppe.*
Observational data of the weather station
Mykolaiv city
Period *- 1946 - 2024 years*

Indicators - atmospheric air temperature
April, October - average monthly temperatures;
July, August - average monthly maximum temperatures;
January - average monthly minimum temperatures.
Source: Ukrainian Hydrometeorological Institute of the State Emergency Service and the National Academy of Sciences of Ukraine

Why this period?

Data loss and fragmentation before 1946
During the Second World War, a significant number of weather stations in Ukraine were destroyed or ceased operations.
Data from this period are often incomplete, fragmented, or lost.

The beginning of systematic data collection after the war
After 1945, the restoration of the meteorological network allowed regular and standardized observations to begin.
Since 1946, data have become more complete and reliable.

Data quality and homogeneity
To create high-quality climate products, long, continuous, and homogeneous observation series are needed.
Data prior to 1946 often do not meet these criteria due to gaps and changes in observation methodology.

Digitization and processing processes
The data since 1946 have been digitized and subjected to quality control and homogeneity procedures, which has created a reliable climate series for research and analysis.

Why these indicators?

April is one of the key spring months, it shows:

- ➔ The beginning of the growing season.
- ➔ The speed of recovery from winter cooling.
- ➔ Changes in spring heat patterns (e.g., early or late warming).

October is the autumn transition month:

- ➔ Indicates how long the heat lasts after summer.
- ➔ It may indicate a delay in the onset of autumn coolness.

Together, April + October provide an indication of the expansion or contraction of the warm season, one of the main indicators of climate change.

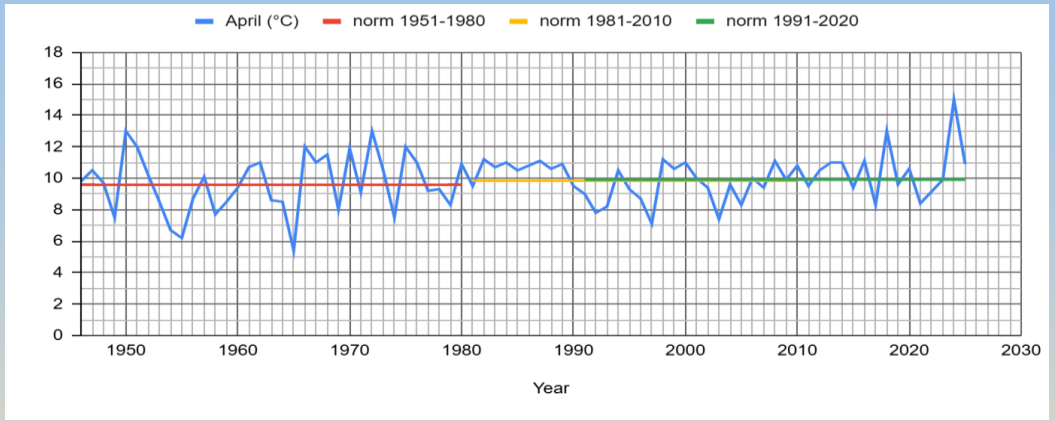
July and August are the hottest months in the temperate continental climate of the northern hemisphere.
Analysis of maximum temperatures allows you to:

- ➔ Track the frequency and strength of heat waves.
- ➔ Identify extreme values, which is especially important for health, energy, and agriculture.
- ➔ Assess the potential heat load on cities (urbanized areas).

January is the coldest month of the year.
Minimum temperatures allow:

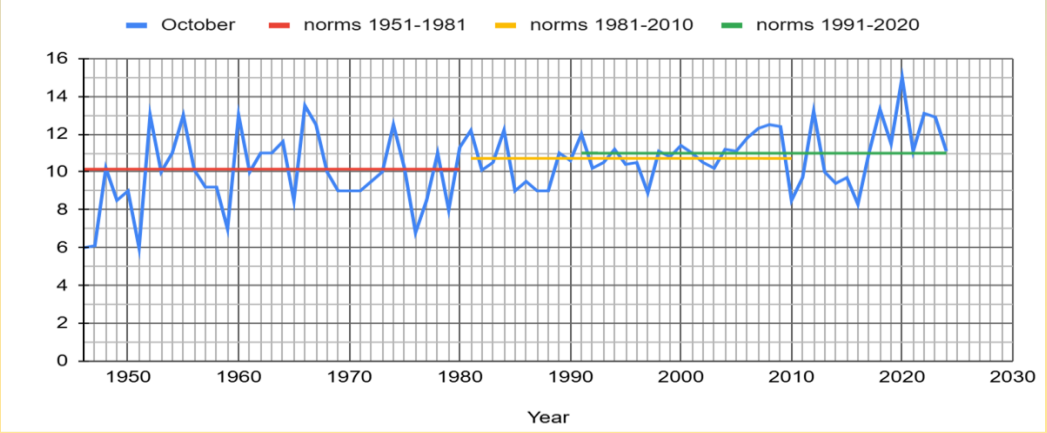
- ➔ Track the warming of winters as part of the overall global warming trend.
- ➔ Change in contrasts and stability of air masses.
- ➔ Reducing the number of extreme frosts.

April



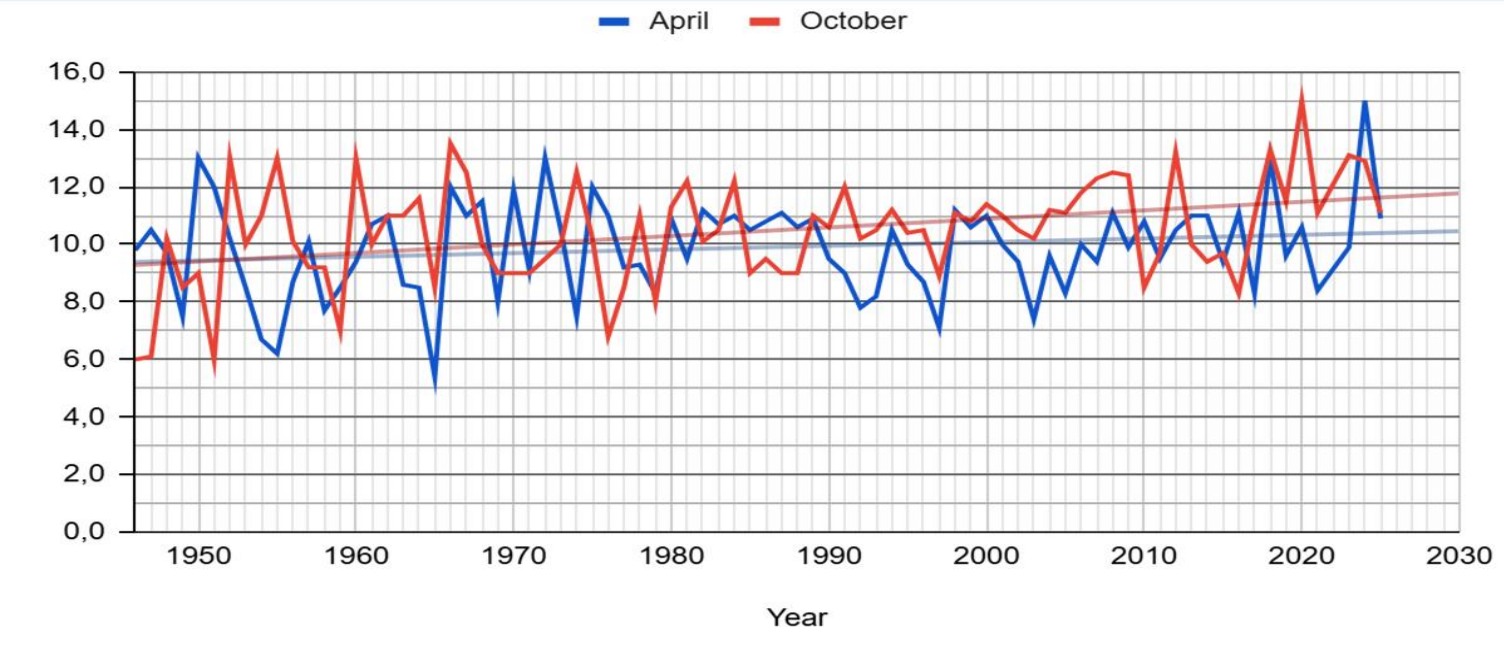
In the 1950s and 1960s, **April** temperatures were typically in the range of **7–11°C**, and in recent decades (2000–2025) they have been mostly **10–13°**C, with isolated peaks of up to **15°C** in 2024.
Average monthly temperature norms for April:
1951–1980: 9.58 °C
1981–2010: 9.84 °C
1991–2020: 9.78 °C

October



October temperatures have increased since the 1950s (typically **8–11**°C) to **11–13°**C in the 2000–2020s, with a maximum of **15°**C in 2020.
Average monthly temperature norms for October:
1951–1980: 10.15 °C
1981–2010: 10.72 °C
1991–2020: 10.99 °C

Comparison of the long-term trend of average monthly temperatures in April - October



Average temperatures (approximate):

April:

1950–1980: 9.5°C
2000–2025: 10.7°C

October:

1950–1980: 9.5–10°C
2000–2025: ~11.2°C

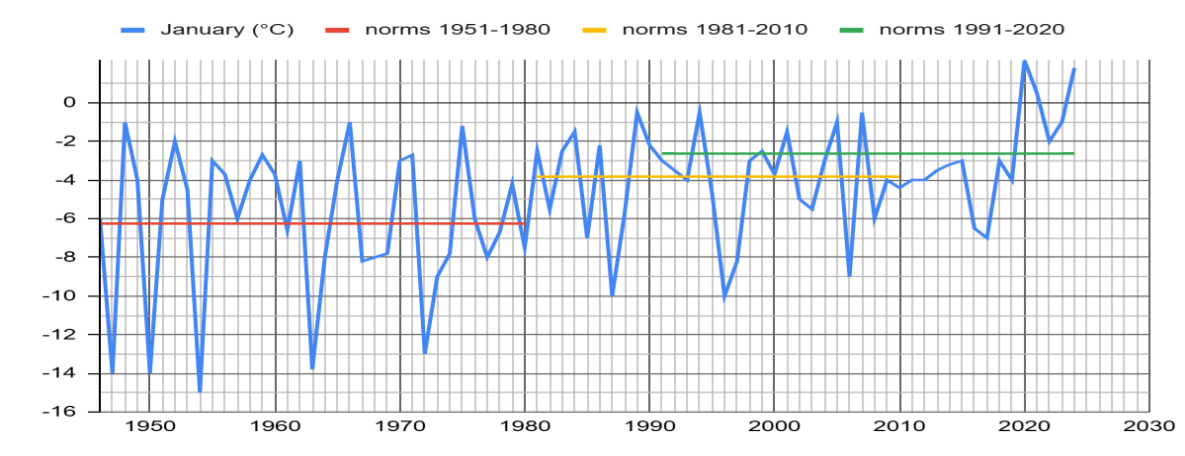
April:

- **Average annual temperature increase: ≈ +0.0123°C/year**
- **Average 10-year increase: ≈ +0.123°C/10 years**

October:

- **Average annual temperature increase: ≈ +0.0291°C/year**
- **Average 10-year increase: ≈ +0.291°C/10 years**

January

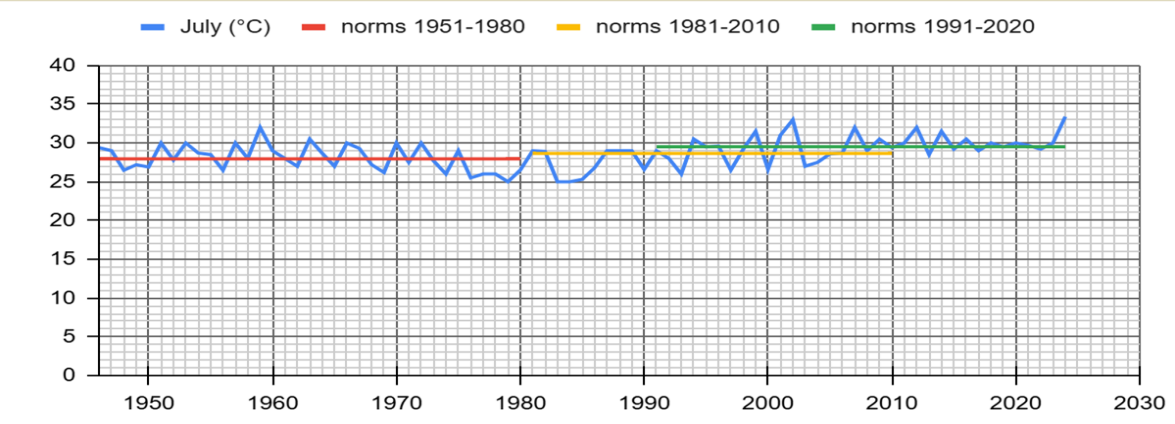


January (winter):

- In the 1940s–1970s, January temperatures often dropped below **-10°**C.
- After the 1990s, there has been a noticeable decrease in frost depth.
- Positive values appear in the 2020s (2020, 2021, 2024) - a sign of winter warming.

January norm:
1951–1980: -6.25°C
1981–2010: -3.82°C
1991–2020: -2.63°C

July

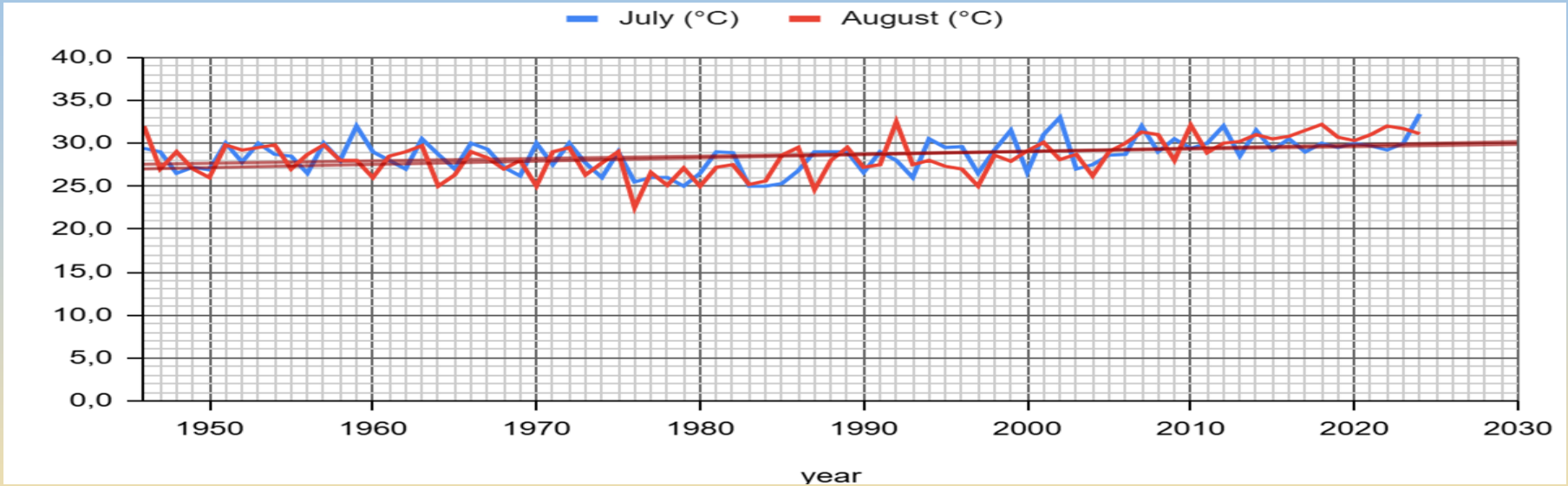


July (summer):

- In the 1940s–1980s, maximums were in the range of **26–30°C.**
- Since the 2000s, peaks above **30°C** have been frequent, with a record high of **33.4°**C in 2024.

July average:
1951–1980: 27.95°C
1981–2010: 28.65°C
1991–2020: 29.52°C

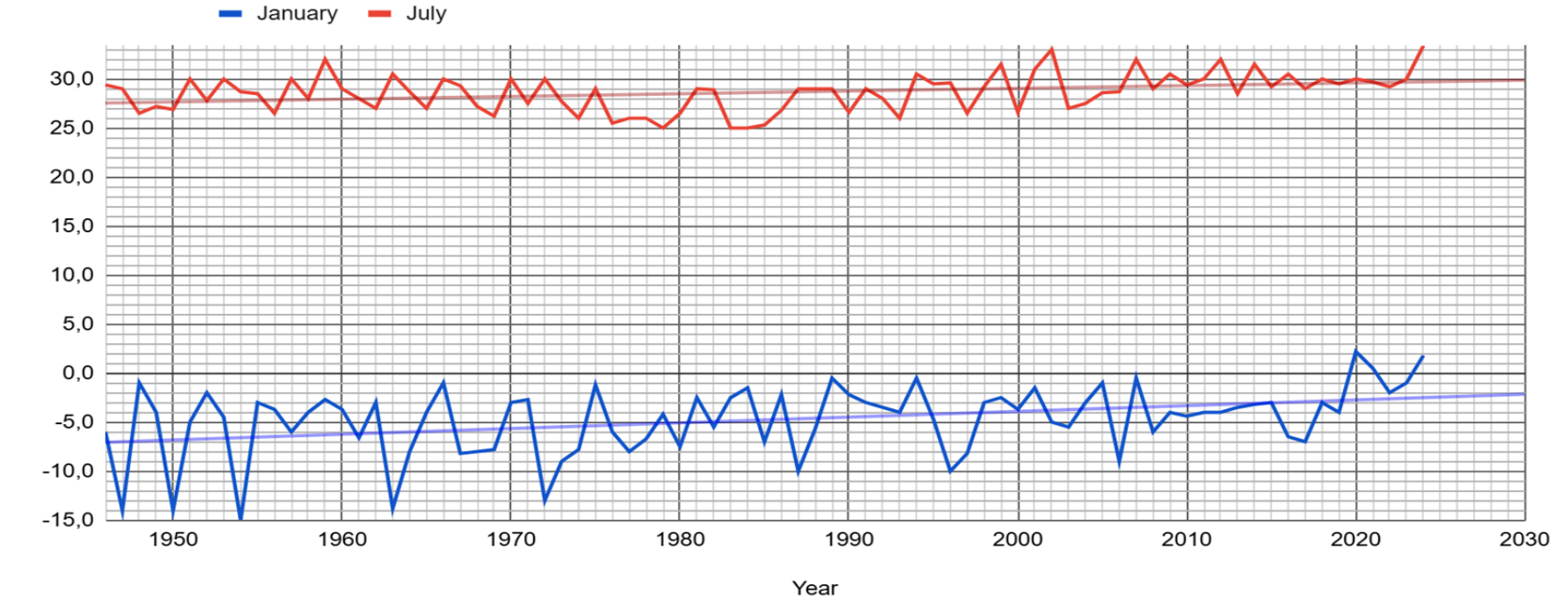
Comparison of the multi-year trend of average monthly temperatures in July-August



- **July** has a distinct trend toward increasing temperatures. Since the 1980s, the average July temperature has increased by more than 1.4°C.
- **August** also shows a noticeable warming, although the fluctuations are larger: an increase of about 1.4°C from 1946–1980 to 1981–2024.

July is often hotter, but since the 2000s, **August** has increasingly "caught up" with or exceeded July—t**his may indicate a shift in the peak of summer heat toward later summer, which is developing with climate change**.

Comparison of the long-term trend of average monthly temperatures in January - July



January

Temperature increases by **≈0.058°C per year or ≈0.58°C per 10 years.** This indicates intense winter warming

July:

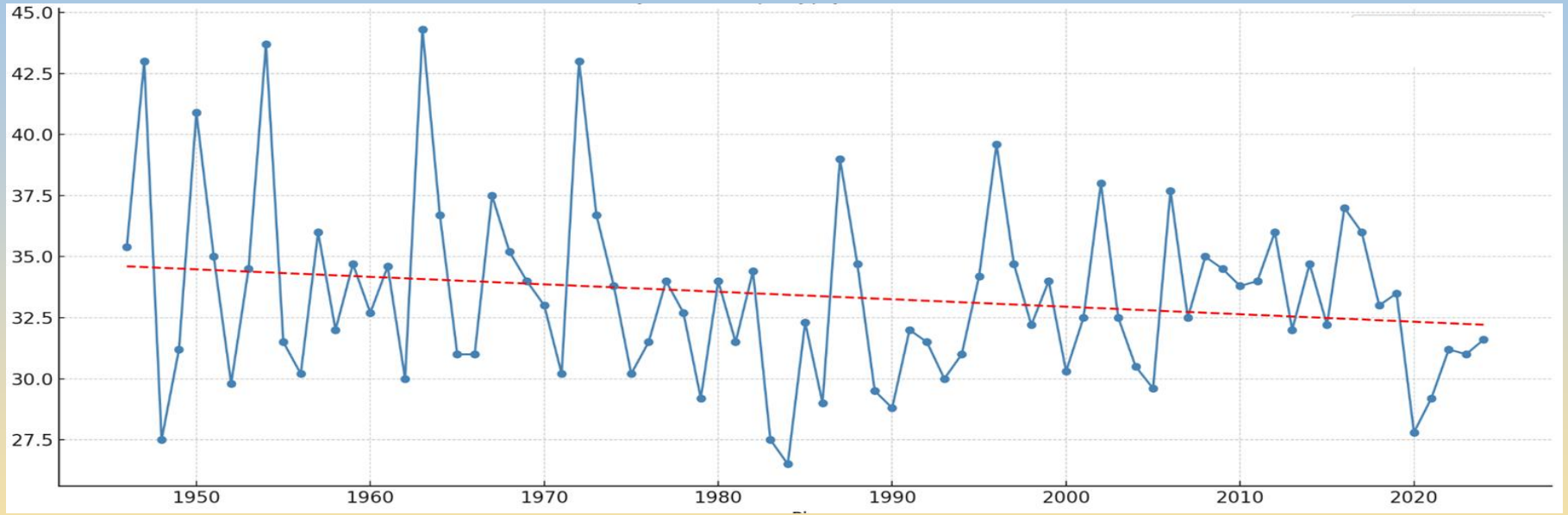
Temperature increases by **≈0.028°C per year or ≈0.28°C per 10 years.** Summer warming is also noticeable, but less rapid

Comparative trends:

➢The temperature gap between January and July is narrowing: winter minimums are decreasing, summer maximums are increasing.

➢This indicates a climate transformation - general warming with extreme weather conditions.

Comparison of the multi-year course of average monthly temperature amplitudes in January - July

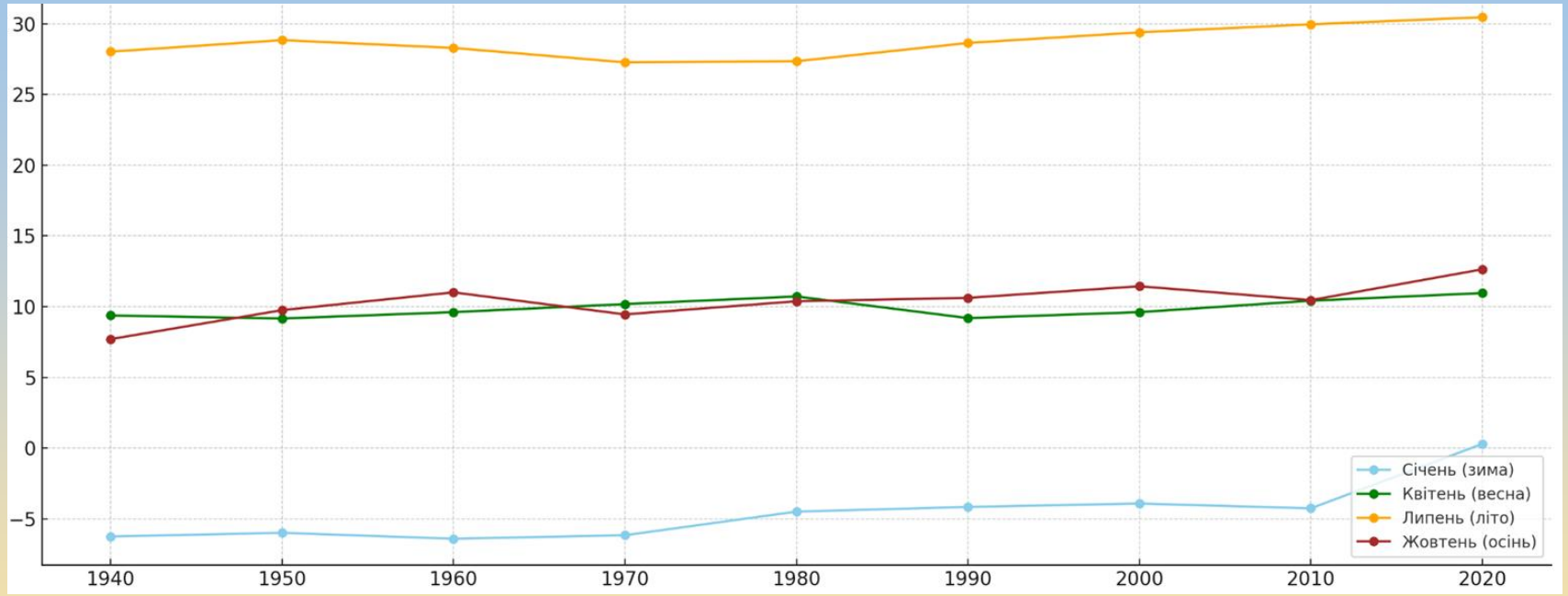


The annual temperature amplitude in Mykolaiv is decreasing

- The largest amplitude is **43.7°C** (1954)
- The smallest amplitude is **27.8°C** (2020)

This is consistent with modern climate change.

Dynamics of seasonal temperatures over decades



Winter (January): gradual but steady warming — from the coldest to almost positive.
Spring (April): slow but steady increase in temperatures.
Summer (July): warming is moderate, but already clearly expressed in the 2020.
Autumn (October): The most pronounced warming of all seasons — a jump from 7.7°C to 12.6°C.
Autumn and winter warmed the most, which is typical for regions with continental climates under the influence of global warming.

Facts

Increase in average annual temperature

- The temperature has increased by an average of 1.2-1.5 °C over the past 50-80 years.
- The warming is most noticeable in the summer months.
- Temperature extremes (+38...+40 °C), which were rare in the mid-twentieth century, are recorded more often.

Consequences

For the climate

- change in atmospheric circulation
- a tendency to reduce precipitation in the summer season and a change in the nature of precipitation
- reduction of days with snow cover

For landscape complexes

- Intensification of wind and water erosion, especially in the conditions of plowing the steppe.
- Changes in surface and groundwater regime
- Processes of desertification of steppe landscapes
- Transformation of natural vegetation (more active spread of xerophytic species, reduction of species diversity)
- Reduction in the number of animal species sensitive to temperature **and hydrological conditions (e.g., gopher, marmot), migration of southern species to the north.**

Thank you for your attention!