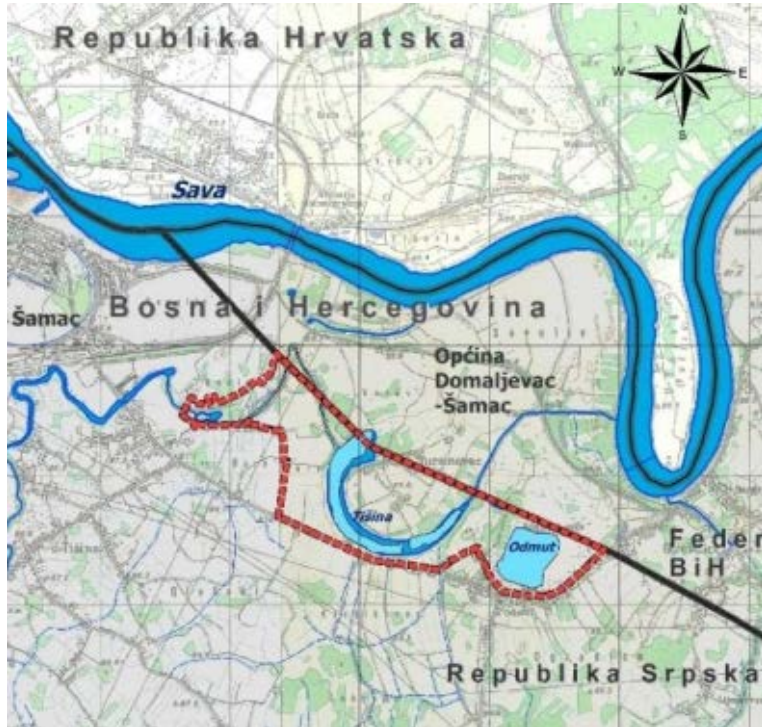


# DEVELOPMENT OF AN ECOSYSTEM RESTORATION PLAN TO ENSURE BIODIVERSITY CONSERVATION IN THE TIŠINA PROTECTED LANDSCAPE IN ŠAMAC MUNICIPALITY

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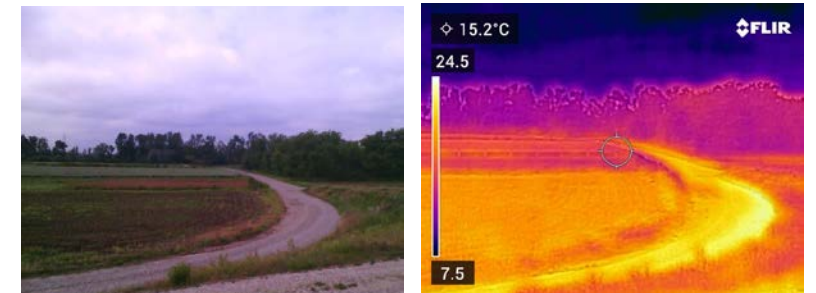
# Introduction



The Tišina Protected Area is a unique wetland ecosystem shaped by the natural forces of the Bosna and Sava rivers

It consists of ponds, floodplain forests, wetlands, and channels

In recent decades, continuous drying of wetland water bodies has been observed, posing severe ecological risks.



## What problems does Tišina face?

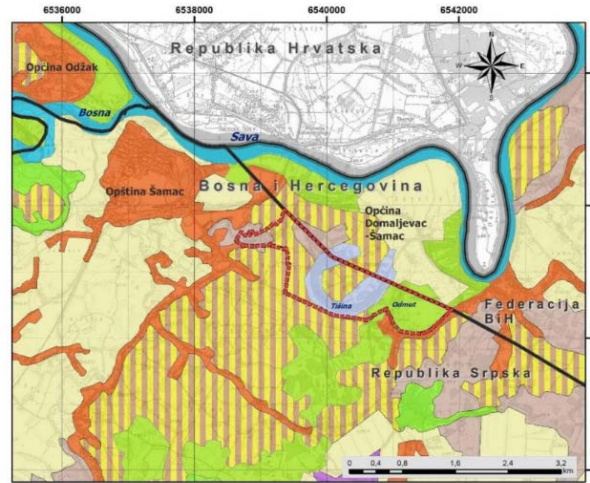
1. Significant water loss in the landscape has been observed
2. Threats to biodiversity
3. Rising temperature in the wider area
4. Increased risks to agriculture





# Tasks

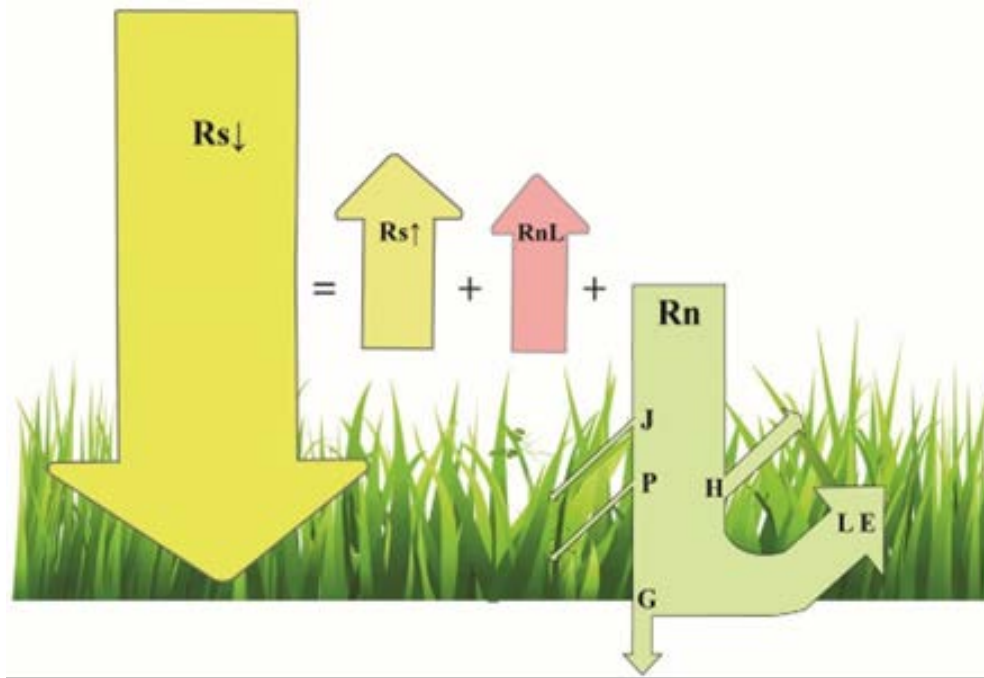
1. Map land use and land cover
2. Analyze hydrology and hydrogeology
3. Identify causes of water loss and assess hydrological balance
4. Examine temperature changes related to climate change
5. Determine key factors driving environmental change
6. Evaluate the impact of specific water loss factors
7. Define conservation goals for the area



## Assumption

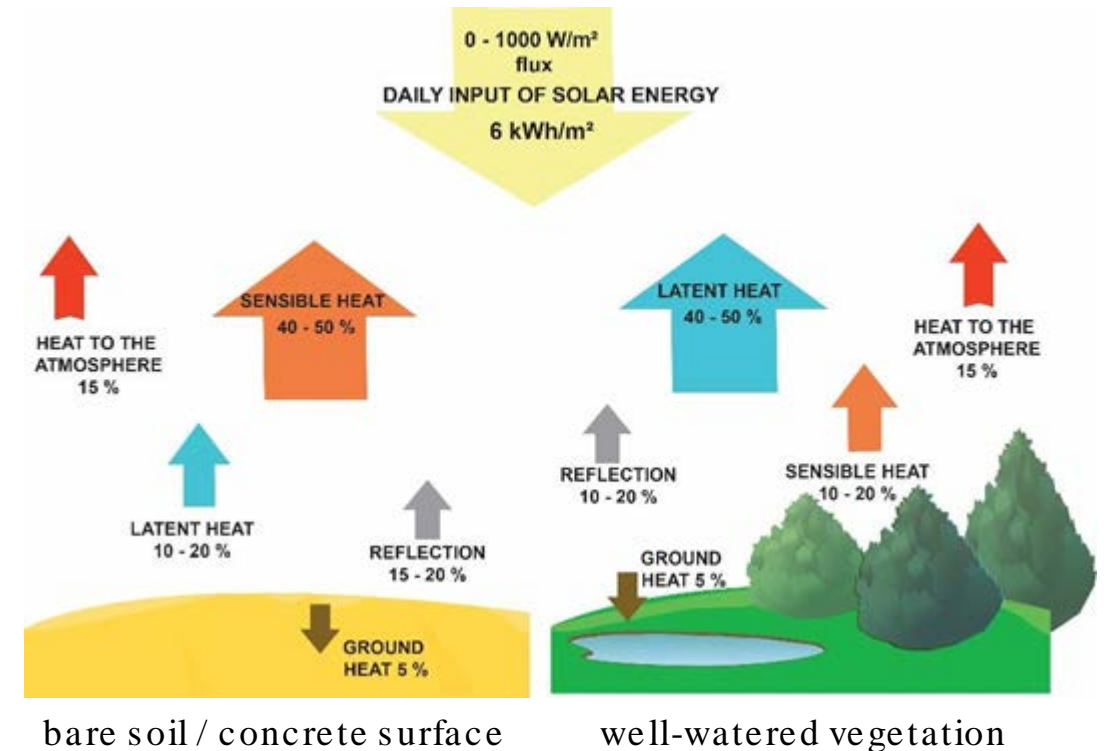
Wetland will be able to maintain lower temperatures compared to the surrounding area, thus acting as a place in the landscape that supports a small water cycle

# Ecological assessment of wetland functions



Solar radiation is the main driver of the processes that take place in the biosphere. The net energy is transformed into evaporation, sensible heat, ground heat flux and photosynthesis.

Wetlands have a high latent heat flux. When wetlands degradation and drainage occur, the distribution of solar radiation changes significantly.





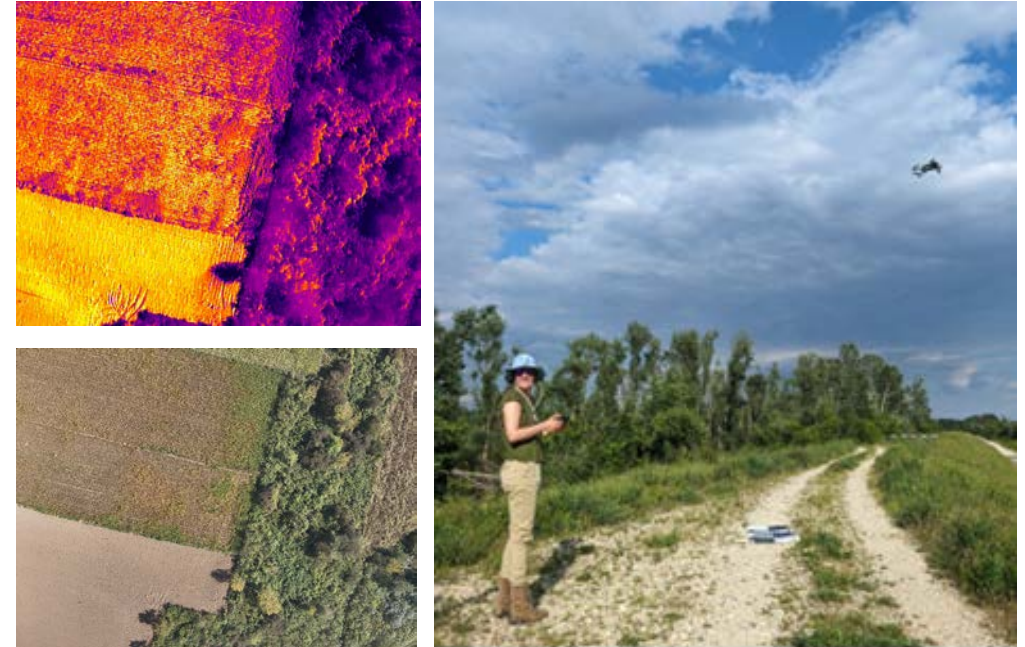
# Methods

## 1. Landsat data



10 dates in July were evaluated from mid-1980s till 2024 in order to observe surface temperature trends

## 2. UAV data survey

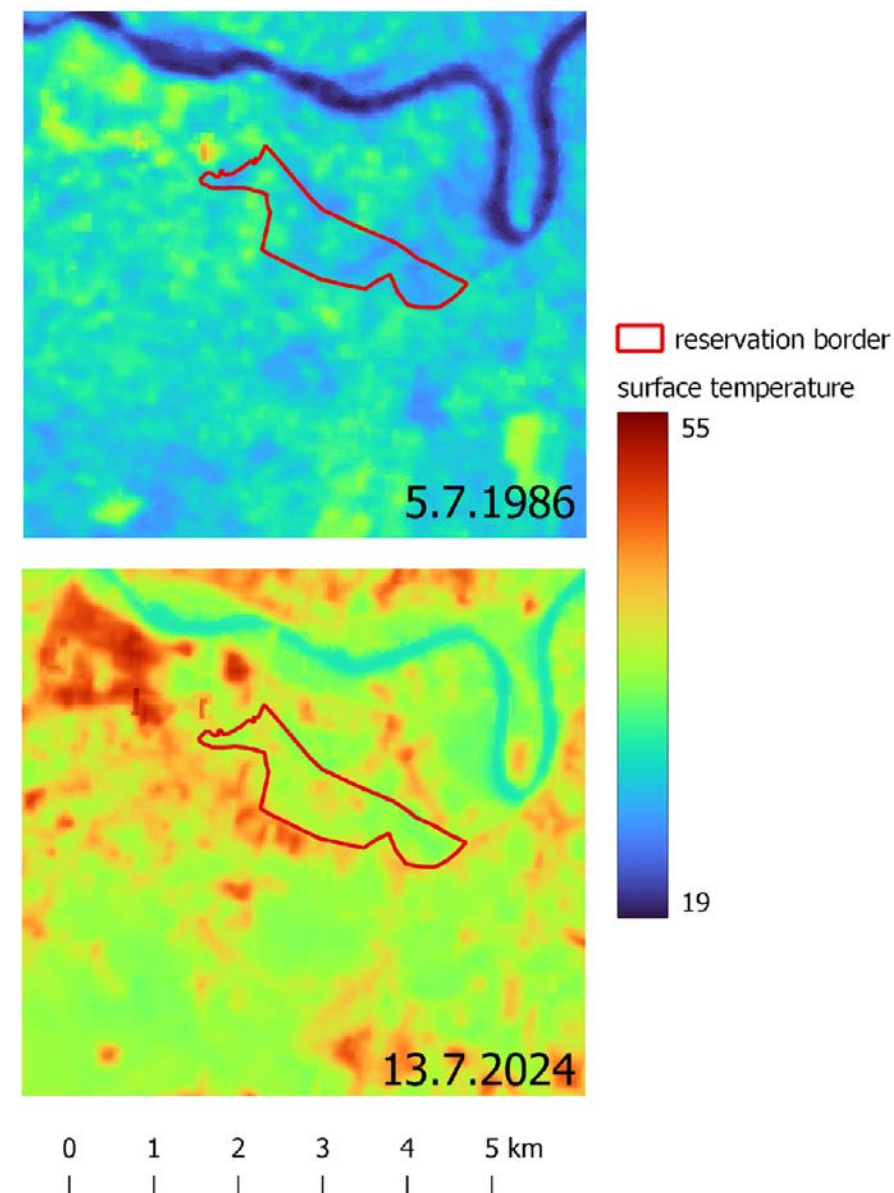
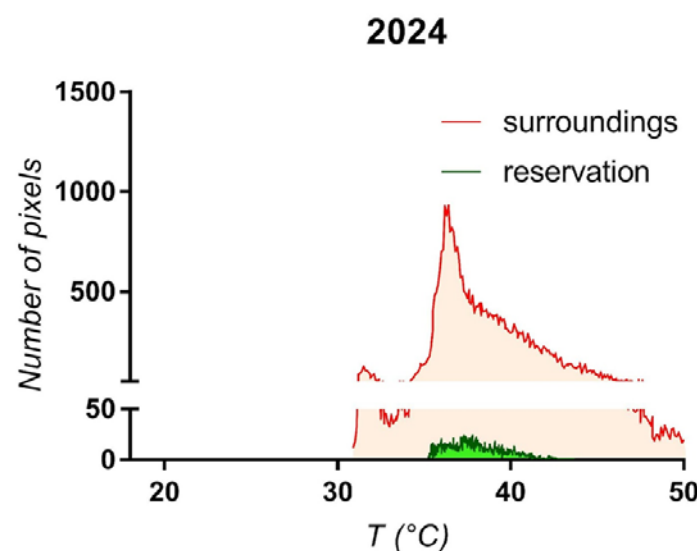
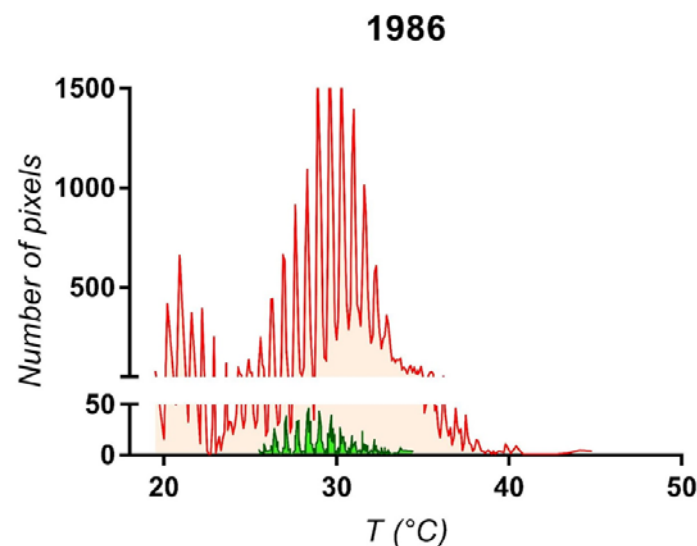


Three data collection campaigns during the 2024 growing season using drones with thermal and multispectral cameras:

- May 9 - 12
- July 12 - 14
- September 21 - 22

# Results

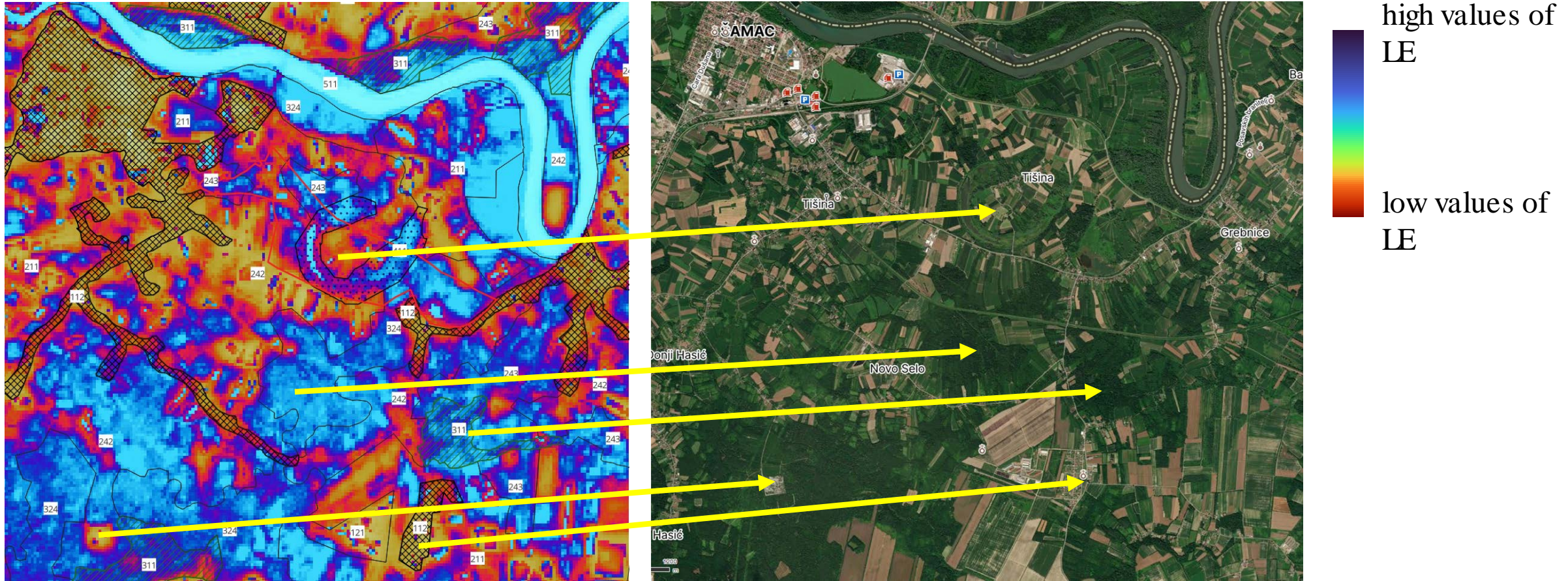
- Tišina is among the coolest areas in the landscape, along with forested region
- Over the time, there has been a continuous shift toward higher temperatures





# Results

13 JULY 2024



Latent heat flux (LE) and Evapotranspiration (E)

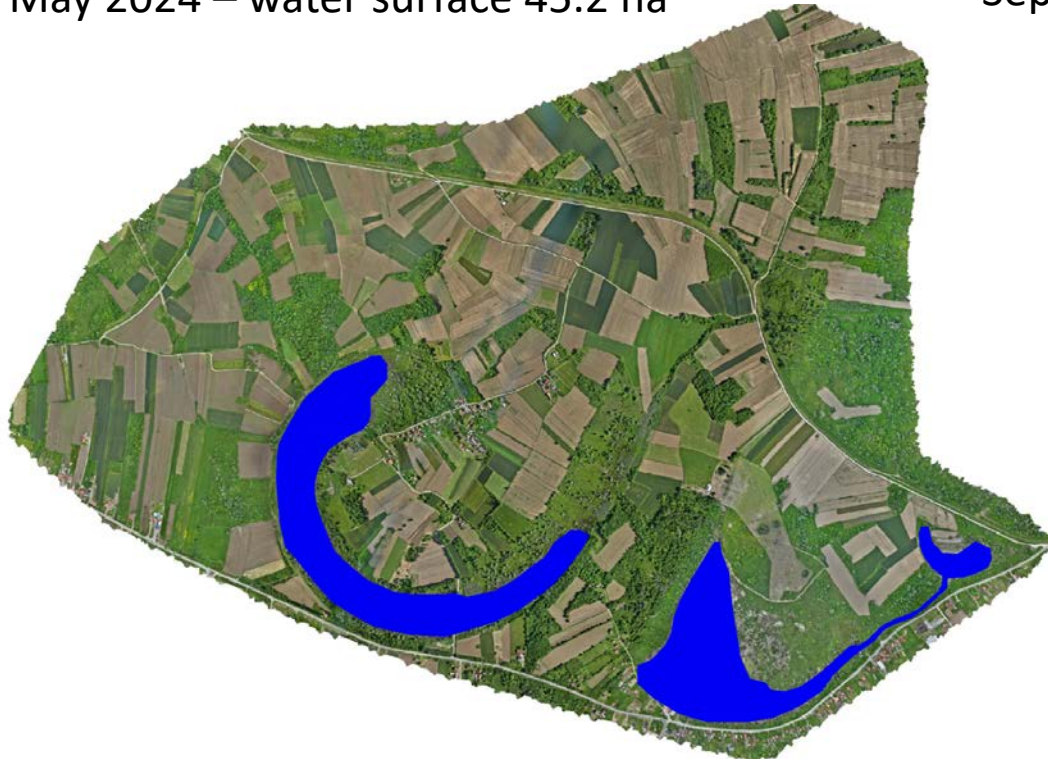
high LE values (landscape cooling): forests, trees, wetlands, wet meadows

low LE values (landscape heating): urban areas, arable land, bare surfaces



# Results

May 2024 – water surface 45.2 ha



September 2024 – water surface 1.3 ha



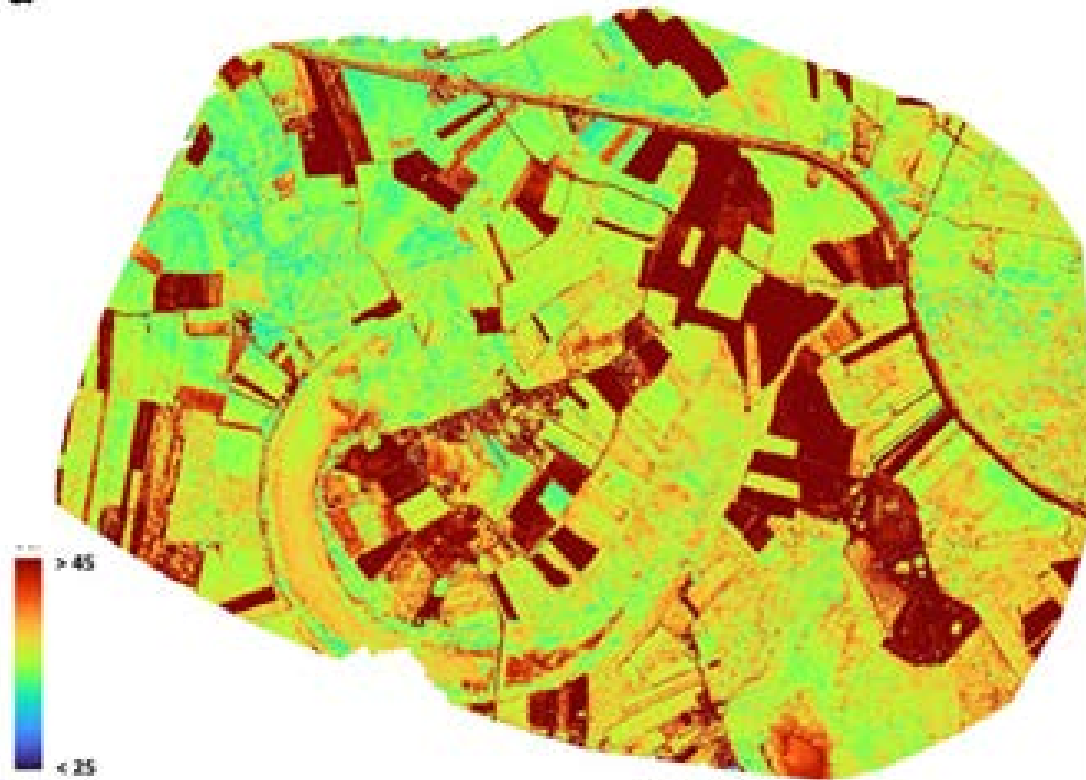
Water loss of  
app. 7 mm per  
day, equivalent  
to over 3500 m<sup>3</sup>  
daily





# Results

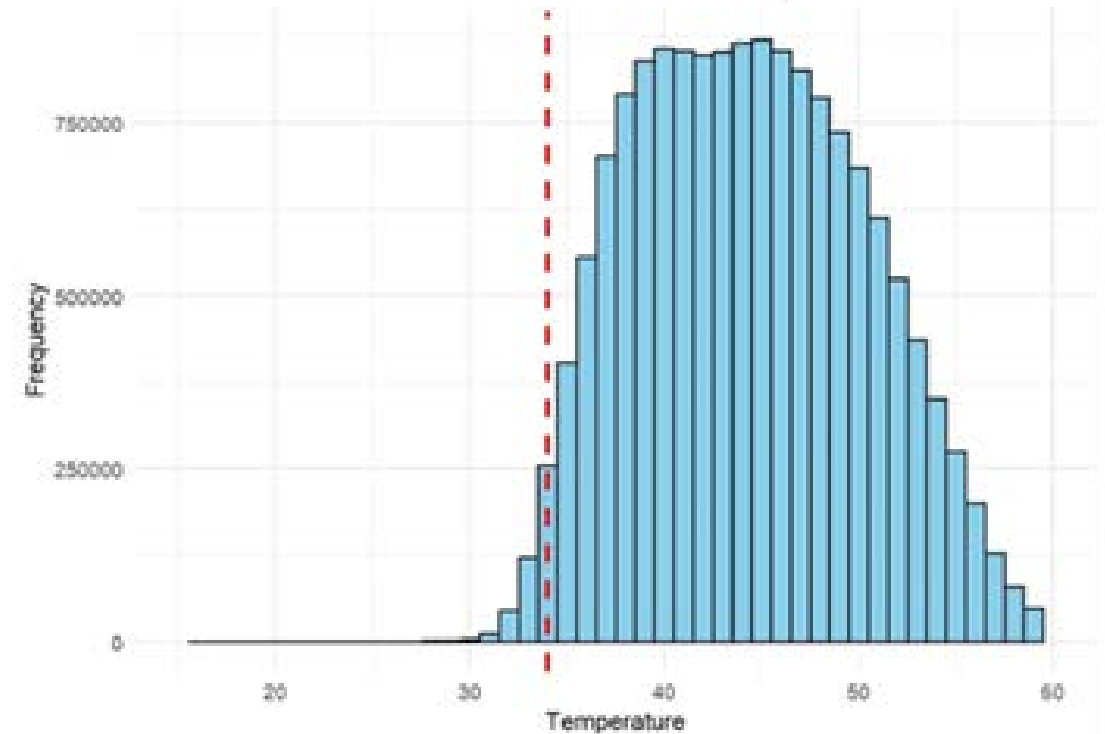
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The **highest temperatures** - bare fields, where surface heating was most intense

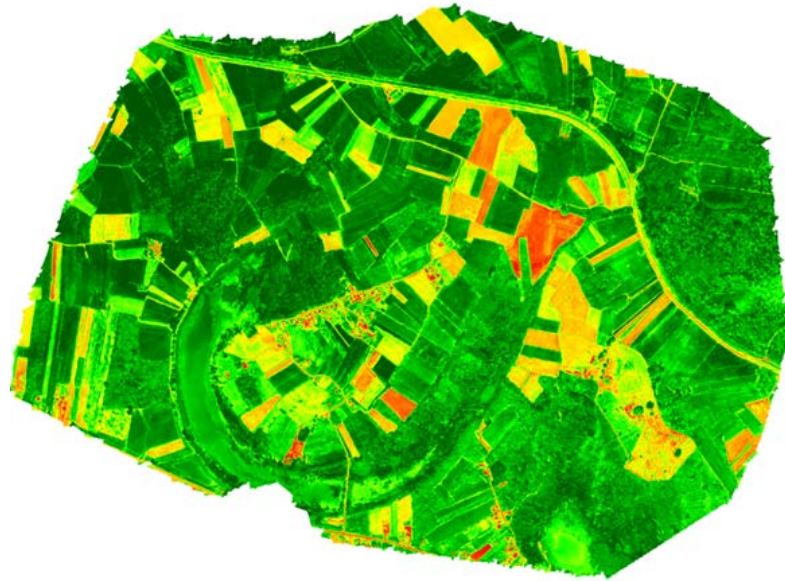
The **lowest temperatures** - areas covered by trees, ponds, and partly agricultural lands, showcasing the cooling effect of vegetation and water bodies


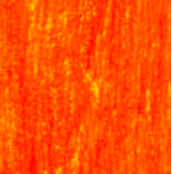

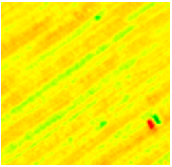

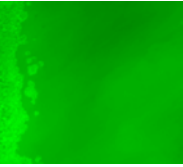

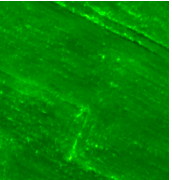

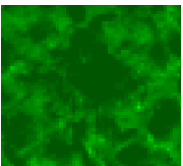

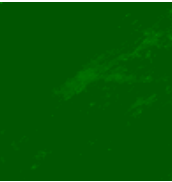
**These cooler zones are critical for buffering against the impacts of extreme heat.**



The average air temperature in the afternoon was 34 °C on July 13<sup>th</sup> (denoted by a red dashed line)

# Results



|                 | visual  | thermo  | min – max      |
|-----------------|---|---|----------------|
| bare soil       |    |    | 56.9 – 60.4 °C |
| harvested field |    |    | 46.4 – 48.1 °C |
| water surface   |    |    | 35.0 – 37.6 °C |
| corn field      |    |    | 34.5 – 36.2 °C |
| Salix           |   |   | 32.3 – 34.7 °C |
| Soya field      |  |  | 31.9 – 33.8 °C |

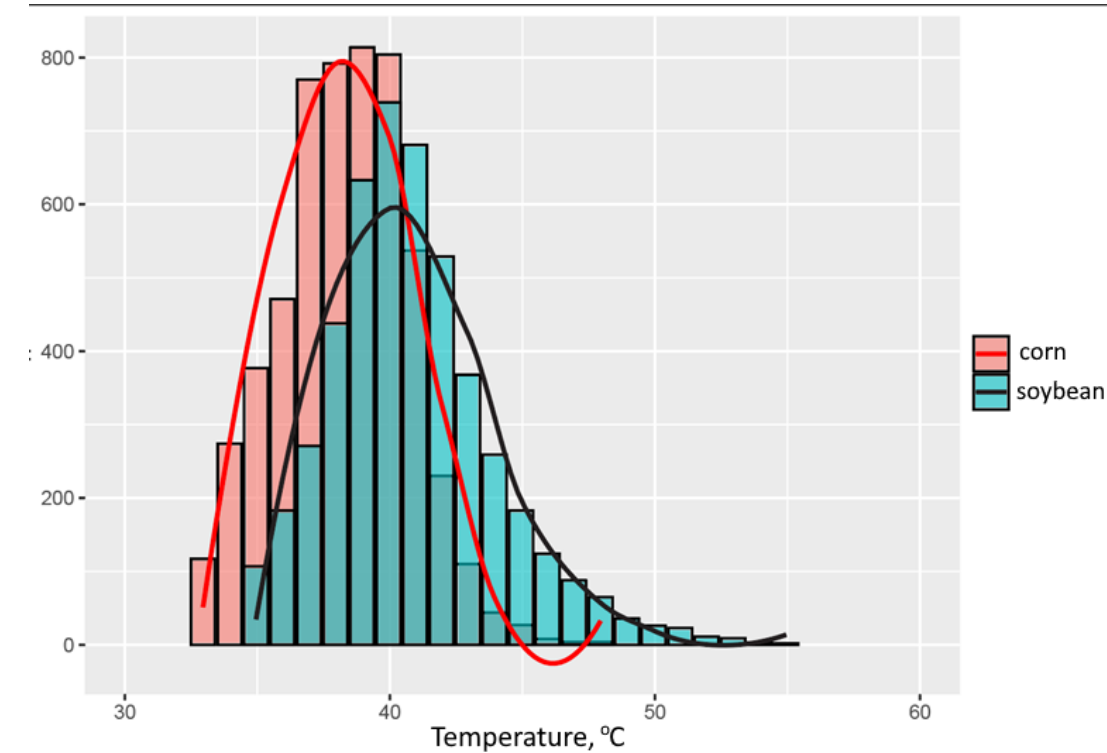
\* Thermal map showing temperature variation across different land cover types (Captured: July 13, 11:40, Ambient temperature: 34°C).





# Results

## Assessment of vegetation density, surface temperature and the distance from wetland



|             |                         | Min, °C | Max, °C | Mean + SD, °C |
|-------------|-------------------------|---------|---------|---------------|
| Campaign II | Field 1 (cornfield)     | 32      | 48      | 38.2 ± 2.5    |
|             | Field 2 (cornfield)     | 36      | 52      | 39.1 ± 1.8    |
|             | Field 3 (soybean field) | 34      | 55      | 40.9 ± 3.2    |

The presence of water near **maize field** helps maintain a relatively stable and cooler temperature. The nearby water source likely has a cooling effect, which can help mitigate temperature extremes. **Soybean field** which lacks a water source nearby and is surrounded by other arable land, experiences a broader range of temperatures.



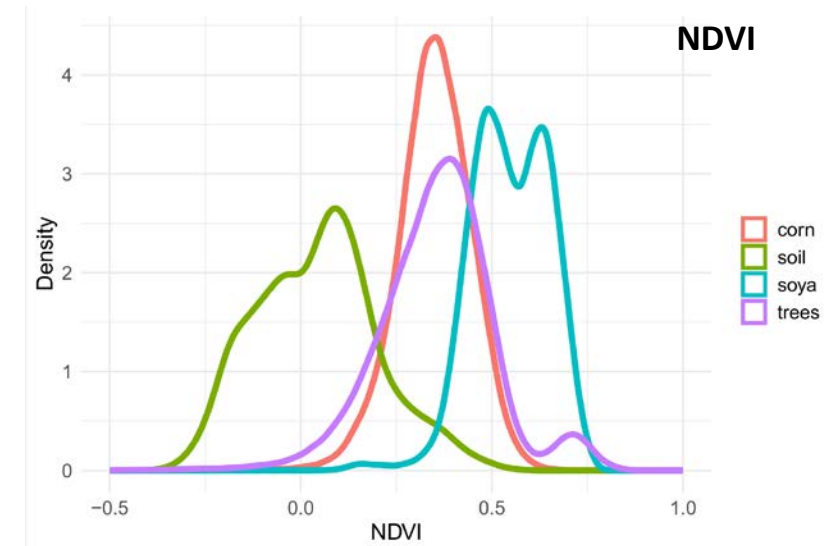
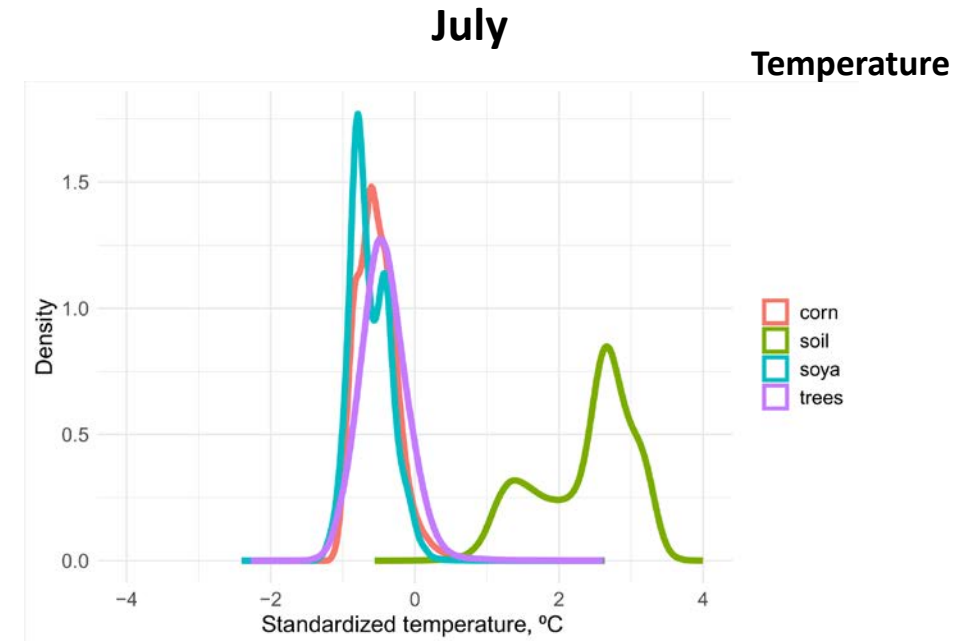
# Results

## *Impact of land cover use on different land cover groups*



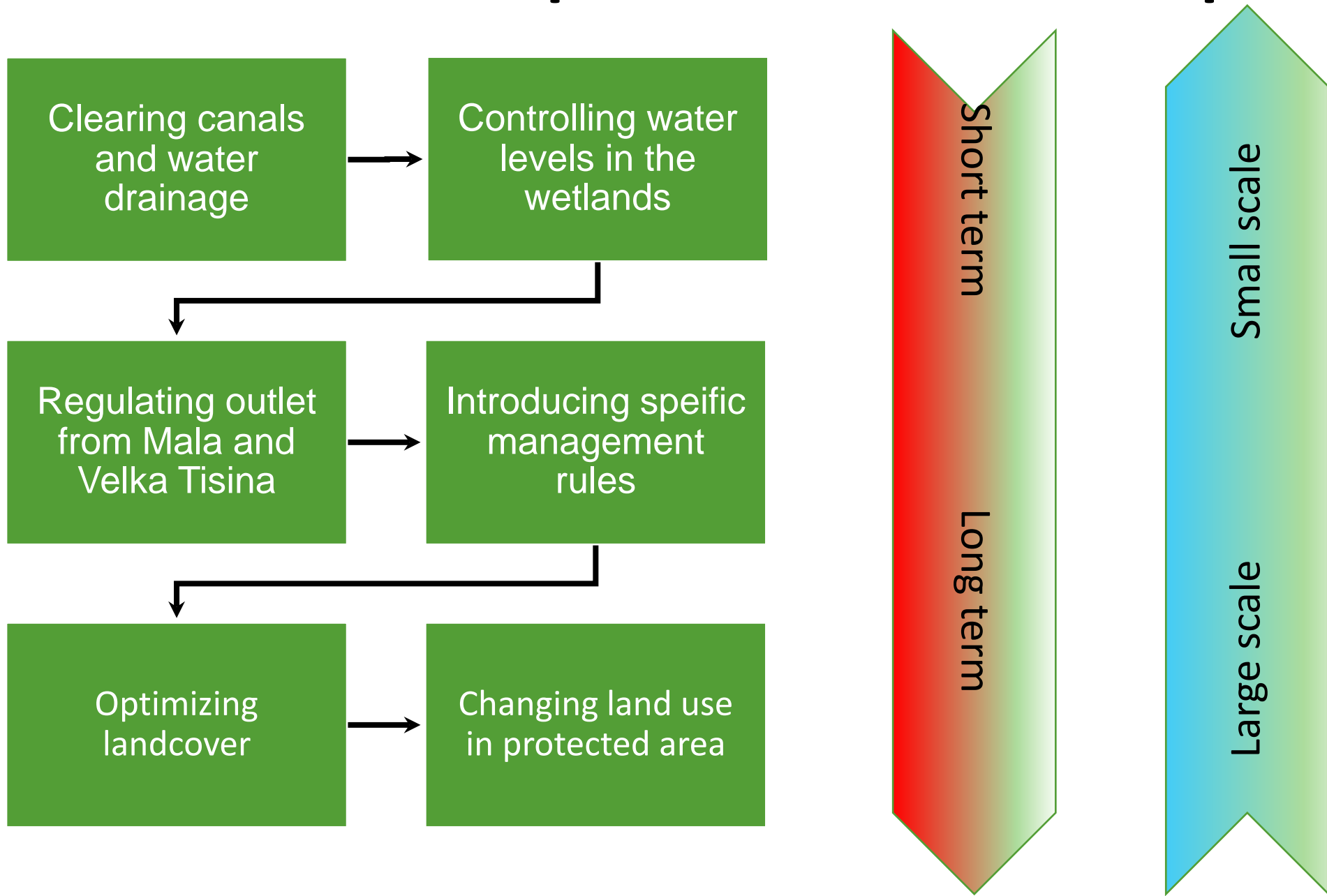
The temperature distributions for three vegetation types exhibit a similar trend. These overlapping distributions may result from the mitigating effect of which stabilize temperature fluctuations.

Soil has lower NDVI values, while vegetation types show higher NDVI peaks. Soya had the densest or most photosynthetically active vegetation





# Proposed restoration steps





The Tišina wetland faces severe ecological challenges due to increased temperatures and water loss. By implementing targeted restoration strategies, it is possible to enhance biodiversity, improve water retention, and mitigate climate change effects in the region.

