Tree – a Natural Air Conditioner

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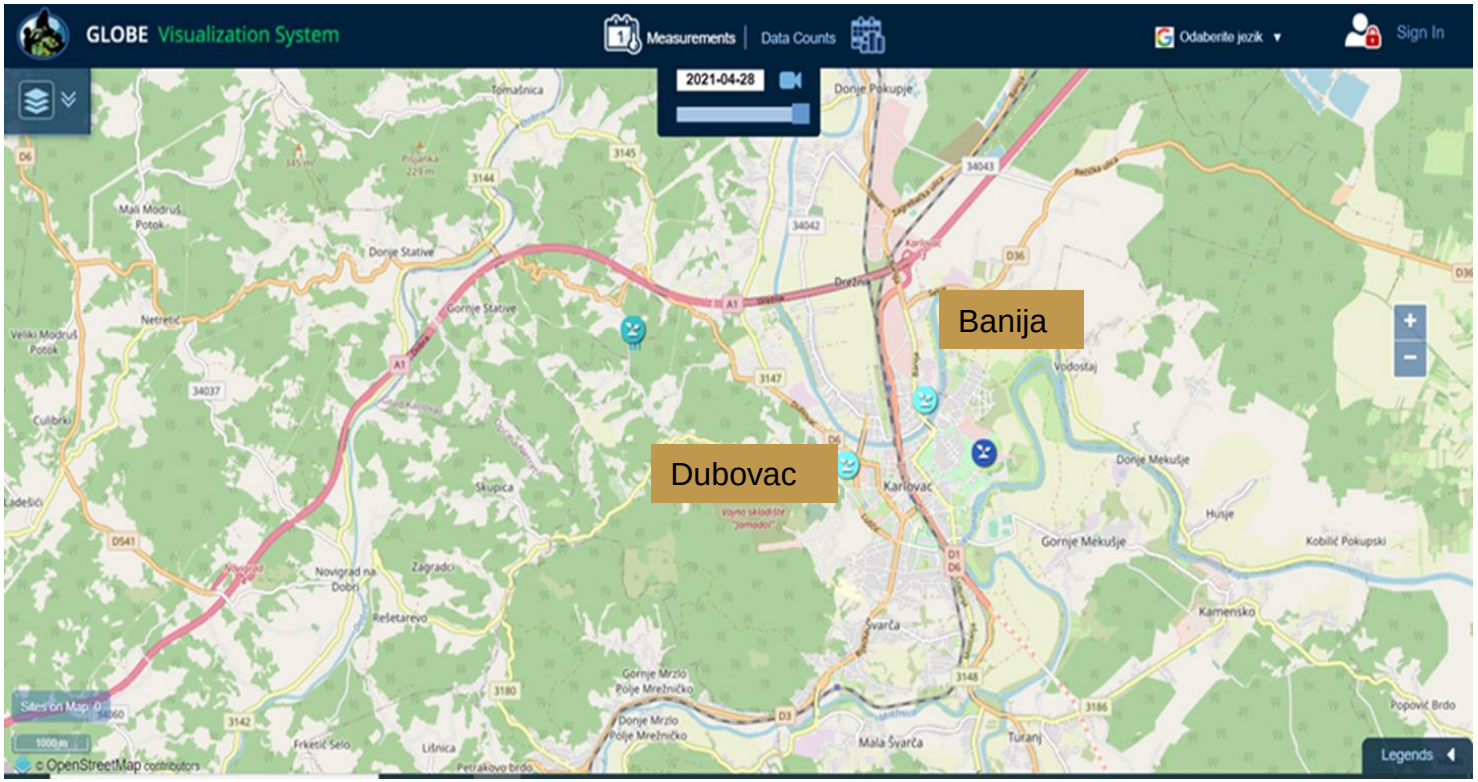
Introduction

For several years our school has been co-operating in the European Phenological Campaign.



Introduction

- We monitor the budding, yellowing and leafing of the birch
- We measure atmospheric parameters
- We measure the surface temperature of the soil

On hot sunny days we recorded measured data in the shade of trees because it was more comfortable.

Then we noticed, near the school, that people were protecting themselves from the sun under a parasol.

We decided to investigate whether it was more pleasent to stay under a parasol or in the shade of a tree on hot days.

We measured:

1. The surface temperature of the soil at:

a) the grassy surface under the birch tree

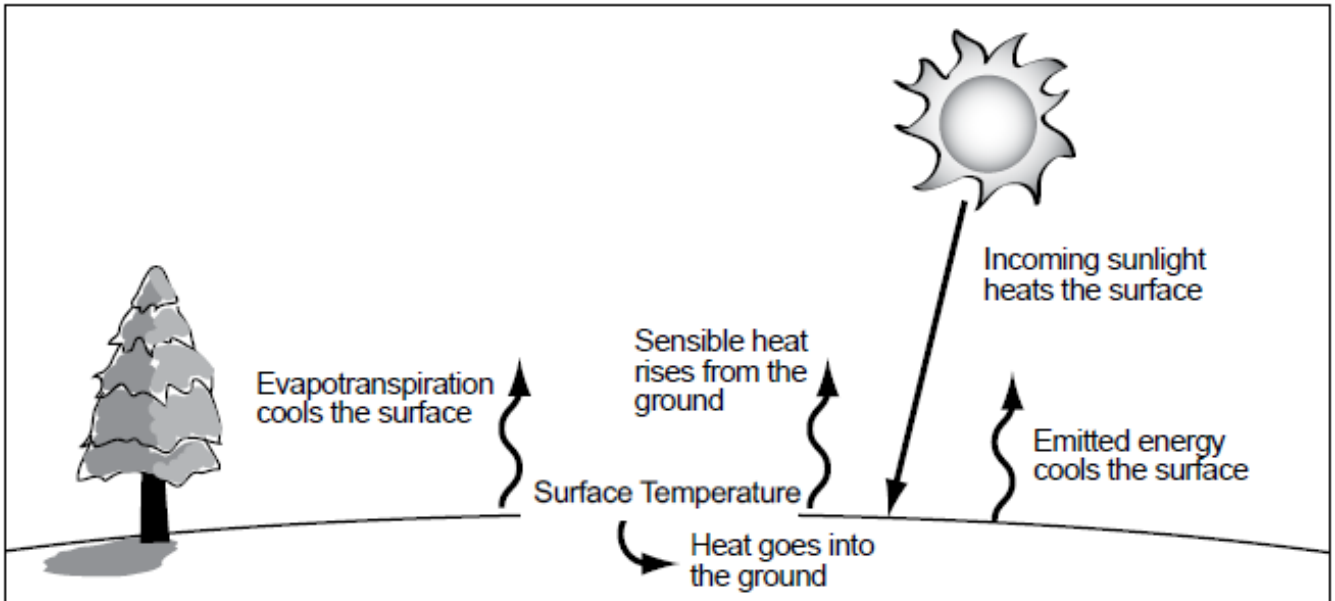
b) the grassy surface under a parasol

c) the grassy sunny surface

2. The current temperature of the air

The surface temperature is the temperature at which energy is emitted from the surface in the form of electromagnetic radiation.

A part of the recieved solar energy is reflected of the ground and a part of the energy is absorbed by the ground which starts to warm up.



Research questions

1. Is the current temperature of the air always lower than the surface temperature of the soil on the sunny grass surface at both stations?

2. Is the surface temperature of the soil on the sunny grass surface always higher than the grass surface under the birch trees and under the parasol at both stations?

3. Will the surface temperature of the soil on the sunny grass surface in the observed period be higher at both stations, if the soil moisture is lower?

Hypotheses

1. The current temperature of the air will always be lower than the surface temperature of the soil on the sunny grass surface on both stations

2. The surface temperature of the soil on the sunny grass surface will always be higher than the surface temperature of the soil on the grassy surface under the birch trees and under the parasol on both stations.

3. The surface temperature of the soil, on both stations, on the sunny grass surface will be higher, if the moisture of the soil is low

Research methods

Research time: 13.6.2022. – 23.9.2022.

(break from 15.7.to 21.8.2022. –school holiday)

Selected day for research:

- hot and warm days
- the amount of cloud cover < 50%.

Time of measuring on both stations:

- 12:15 opening of the parasol on the sunny grass surface
- 12:30 measuring of the surface temperatures on different surfaces
- 12:30 measuring the current air temperature on the atmospheric stations

Chosen birch trees for measuring the surface temperature in the shade:

Measuring the height of the trees- GLOBE Observer

Birch - OŠ Dubovac has 19,10 m

Birch - OŠ Banija has 20,45 m

Surface temperature measurment according to the GLOBE protocol

Station OŠ Dubovac - Voltcraft IR Thermometar IR 260-85

Station OŠ Banija - ANENG AN 550 IR Thermometer

Locations of surface temperature measurments in OŠ Dubovac and OŠ Banija:

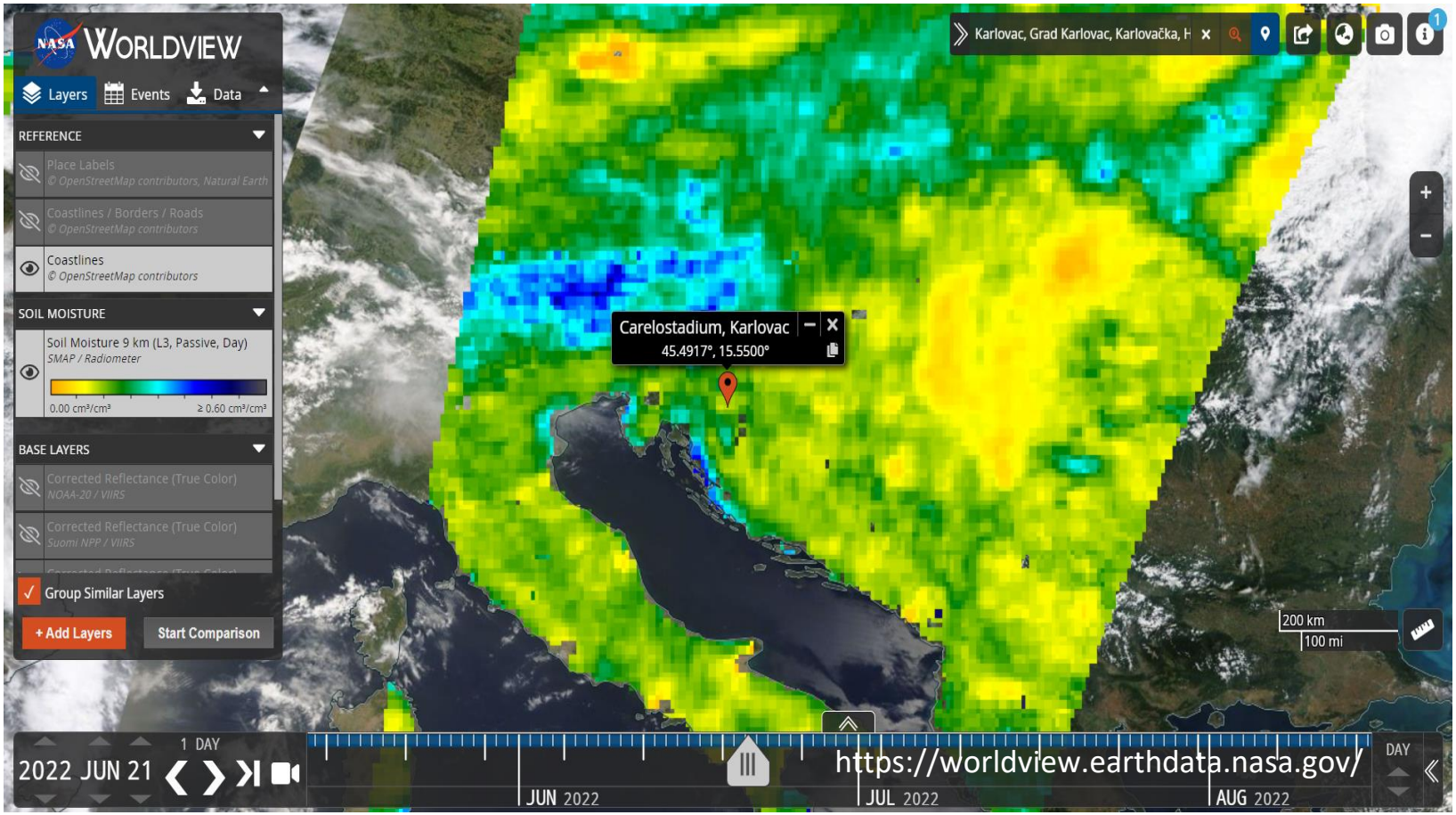
a) grassy surface under the birch trees

b) grassy surface under the parasol

c) sunny grass surface

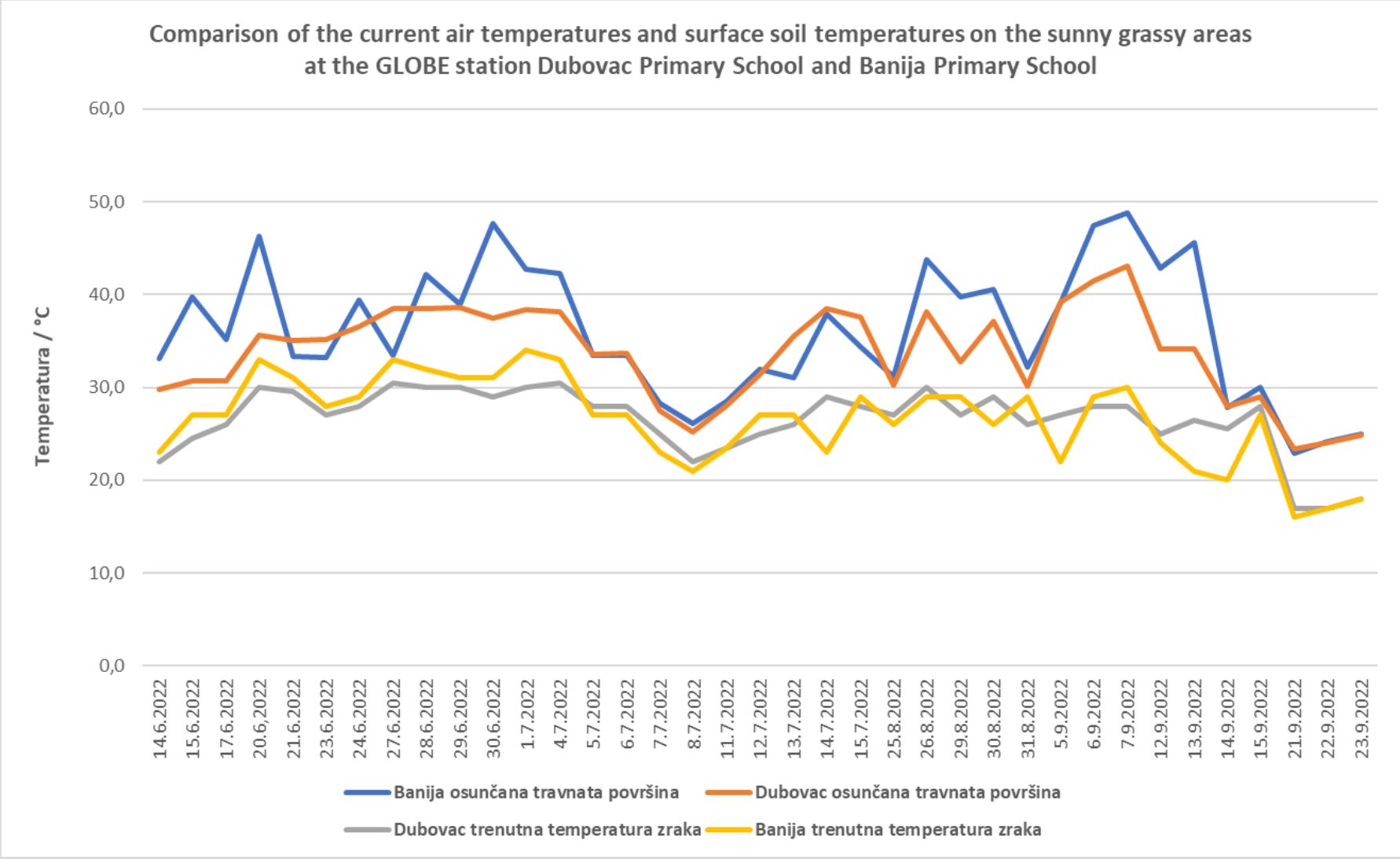
Data on soil moisture– we downloaded from the SMAP satellite database for Karlovac

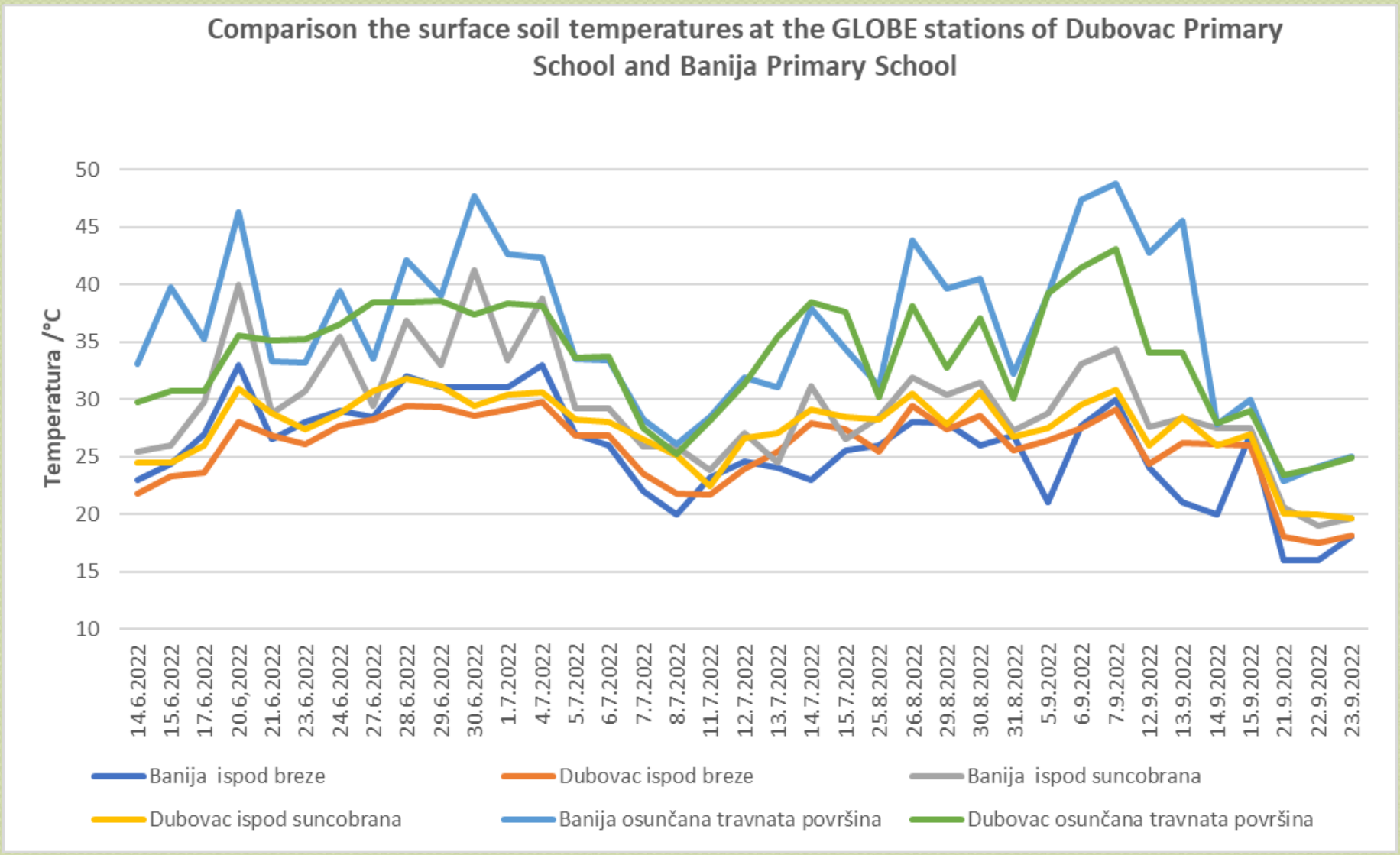
We analyzed the satellite data with the help of Brian Campbell (NASA Senior Earth Science Education and Communication Lead)

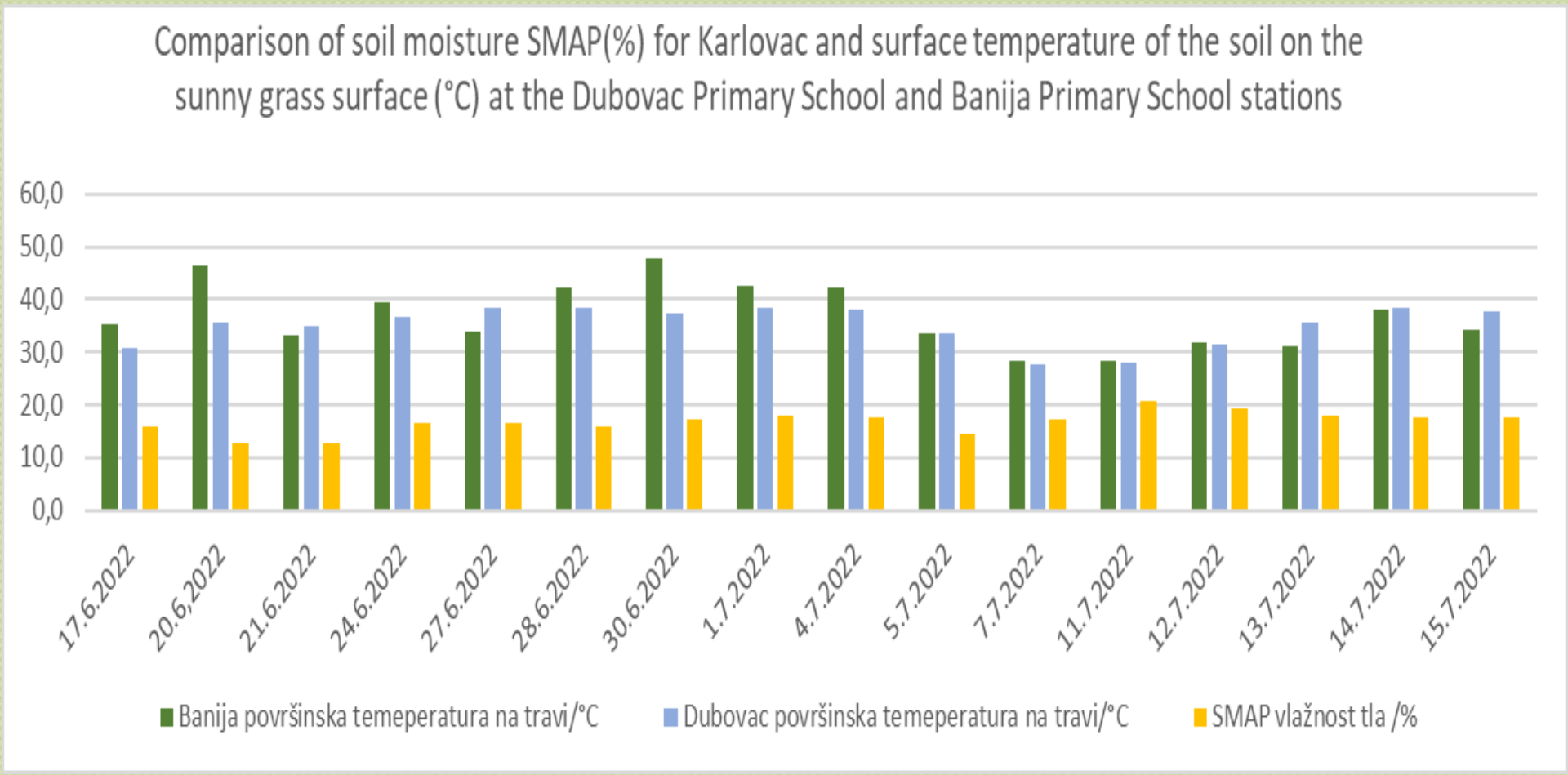


The results

for 37 warm and hot days in the researched period




Comparison the surface soil temperatures at the GLOBE stations of Dubovac Primary School and Banija Primary School
Temperatura /°C
50
45
40
35
30
25
20
15
10
14.6.2022
15.6.2022
17.6.2022
20.6,2022
21.6.2022
23.6.2022
24.6.2022
27.6.2022
28.6.2022
29.6.2022
30.6.2022
1.7.2022
4.7.2022
5.7.2022
6.7.2022
7.7.2022
8.7.2022
11.7.2022
12.7.2022
13.7.2022
14.7.2022
15.7.2022
25.8.2022
26.8.2022
29.8.2022
30.8.2022
31.8.2022
5.9.2022
6.9.2022
7.9.2022
12.9.2022
13.9.2022
14.9.2022
15.9.2022
21.9.2022
22.9.2022
23.9.2022
Banija ispod breze
Dubovac ispod breze
Banija ispod suncobrana
Dubovac ispod suncobrana
Banija osunčana travnata površina
Dubovac osunčana travnata površina


Comparison of soil moisture SMAP(%) for Karlovac and surface temperature of the soil on the sunny grass surface (°C) at the Dubovac Primary School and Banija Primary School stations
60,0
50,0
40,0
30,0
20,0
10,0
0,0
17.6.2022
20.6.2022
21.6.2022
24.6.2022
27.6.2022
28.6.2022
30.6.2022
1.7.2022
4.7.2022
5.7.2022
7.7.2022
11.7.2022
12.7.2022
13.7.2022
14.7.2022
15.7.2022
Banija površinska temeperatura na travi/°C
Dubovac površinska temeperatura na travi/°C
SMAP vlažnost tla /%

Conclusions and discussions

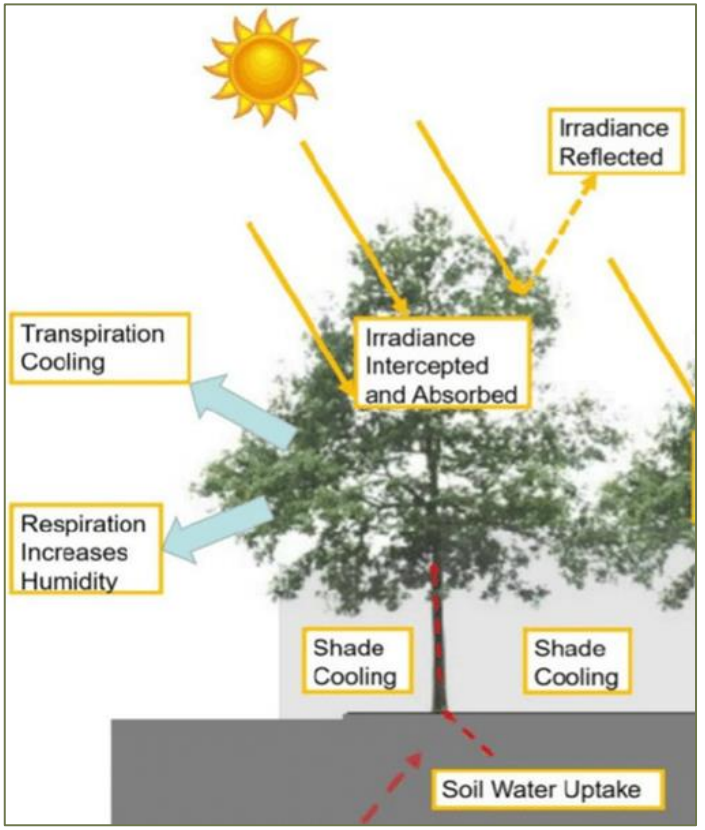
1. The current air temperature is always lower than the surface temperature of the soil on the sunny grass surface on both stations

2. The surface temperature of the soil on the sunny grass surface is always higher than the surface temperature of the soil on the grassy surface under the birch trees and under the parasol on both stations.

The surface temperature of the soil under the tree is lower because the tree with all its leaves absorbs solar energy.

In this process respiration and transpiration occur on the leaves, so the leaves cool down.

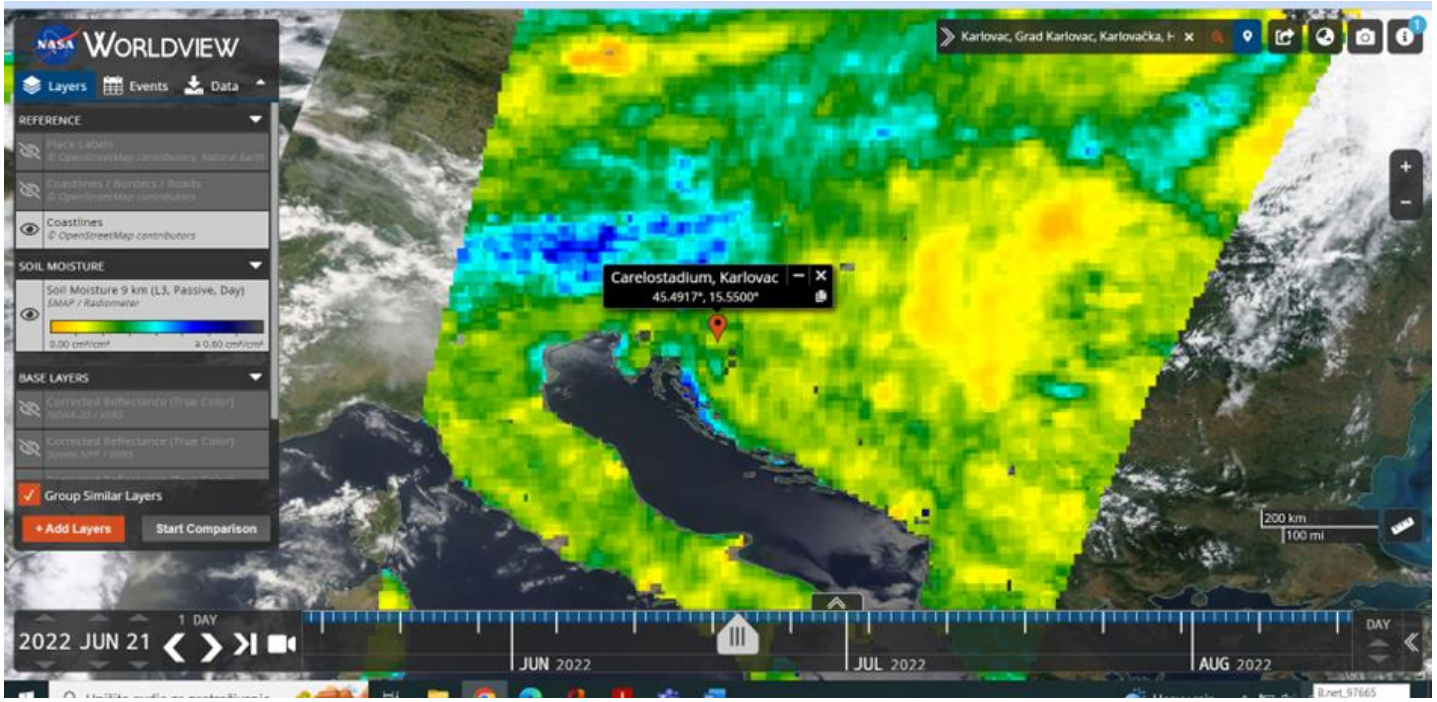
Transpiration and respiration on the leaves has a cooling effect and increases the humidity in the air, so the tree can act as an air conditioner on warm and hot days.



The parasol with its surface partially reflects and partially absorbs solar energy but has no cooling effect (respiration and transpiration).

To confirm our 3rd hyphotesis that the lower the soil moisture, the higher the soil surface temperature will be on the sunny grass area at both stations we should have more soil moisture data.

In the observed period of surface temperature measurment, soil moisture (SMAP) was always lower than 20.7% which is the lower limit for optimal tree growth.

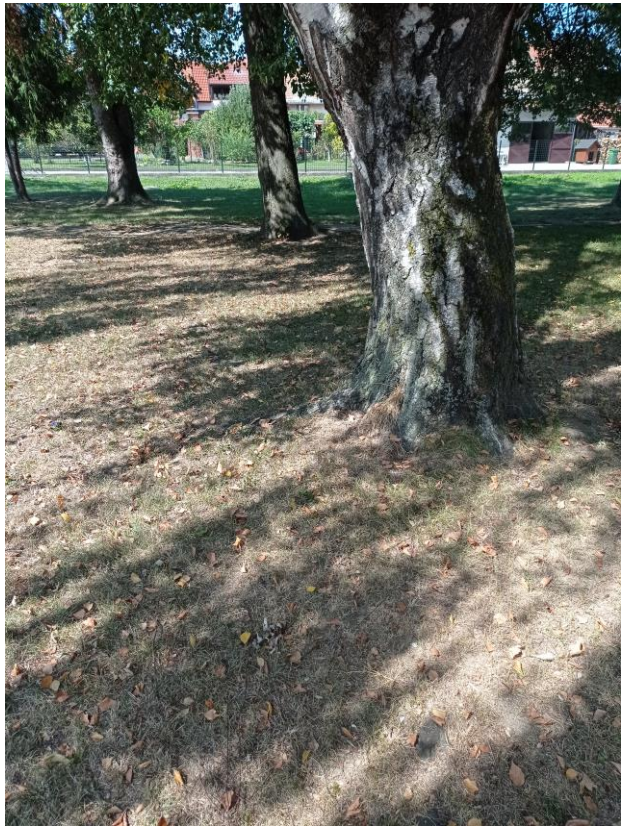


Possible causes of differences in measured current air temperatures at both stations:

-microclimatic differences and spatial environment

Possible causes of differences in measured soil temperatures on sunny grass surfaces and grass surfaces under the birch trees and the parasol:

-different sizes of vegetation on the measured surfaces



Since the city of Karlovac is known for its river tourism, we recommend that more trees should be planted on the banks of the rivers, which will replace the parasols.

Even though the city of Karlovac is the city of parks, there are not enough trees in some districts, so we suggest planting them to make the city more pleasent to live in in the summer.

Sources

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Thank you for your attention