

Solar energy – vegetation – water in the landscape: The new teaching methodology on air-conditioning function of vegetation for pre-service biology teachers

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Program **Éta**



Pedagogická
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v Českých Budějovicích
University of South Bohemia
in České Budějovice



Why is it important to teach about the role of vegetation in solar energy distribution ?

Increasing continental drought !

Global water crisis !

Rising global temperatures !

X

General lack of knowledge about the role of vegetation in mitigation of these consequences of climate changes resulting in the wrong landscape management

Phenomenon of „Plant blindness“

Missing or underestimated topics in Czech science curriculum (solar energy distribution in the landscape, transpiration)

Misconceptions about the physiological role of vegetation in the landscape





Way out? Education of future educators!

- ▶ New teaching methodology developed through a project supported by Technology Agency of the Czech Republic (TACR) by joined co-operation of scientists and educators from Faculty of Education at the University of South Bohemia, and scholars from the scientific institution ENKI, o.p.s, long experienced in the field of landscape ecology
- ▶ Three versions of methodology: a) **university students (pre-service biology teachers)**, b) basic school pupils and in-service biology teachers, c) municipal employees (under the auspices of lifelong learning).
- ▶ Development of the methodology in 2018 – 2020, (2018 study of students' pre-instructional conceptions and piloting of outdoor activities using modern measuring devices – 2019 assessment + development and thesting of the learning activities 2020 – assessment and finalization.
- ▶ All versions available free online in Czech language <https://projekty.pf.jcu.cz/svv/>



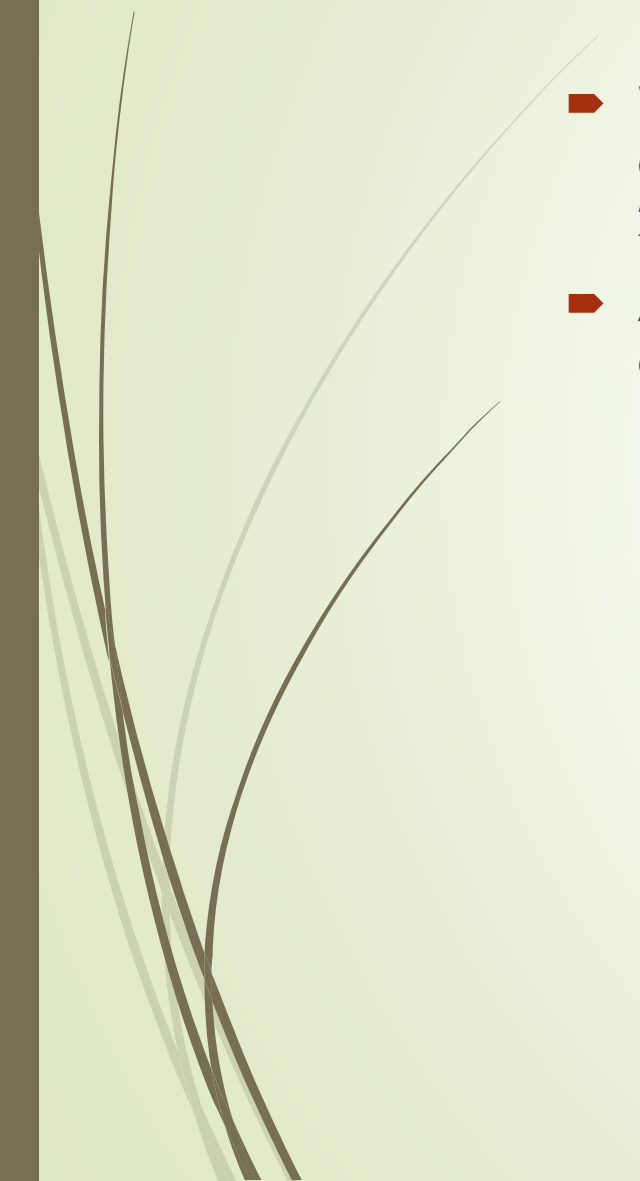
The new teaching methodology includes:
Methodological sheets for university educators
Worksheets for students
Recommended and proved set of measuring devices
Videoshots

Modern teaching approaches:

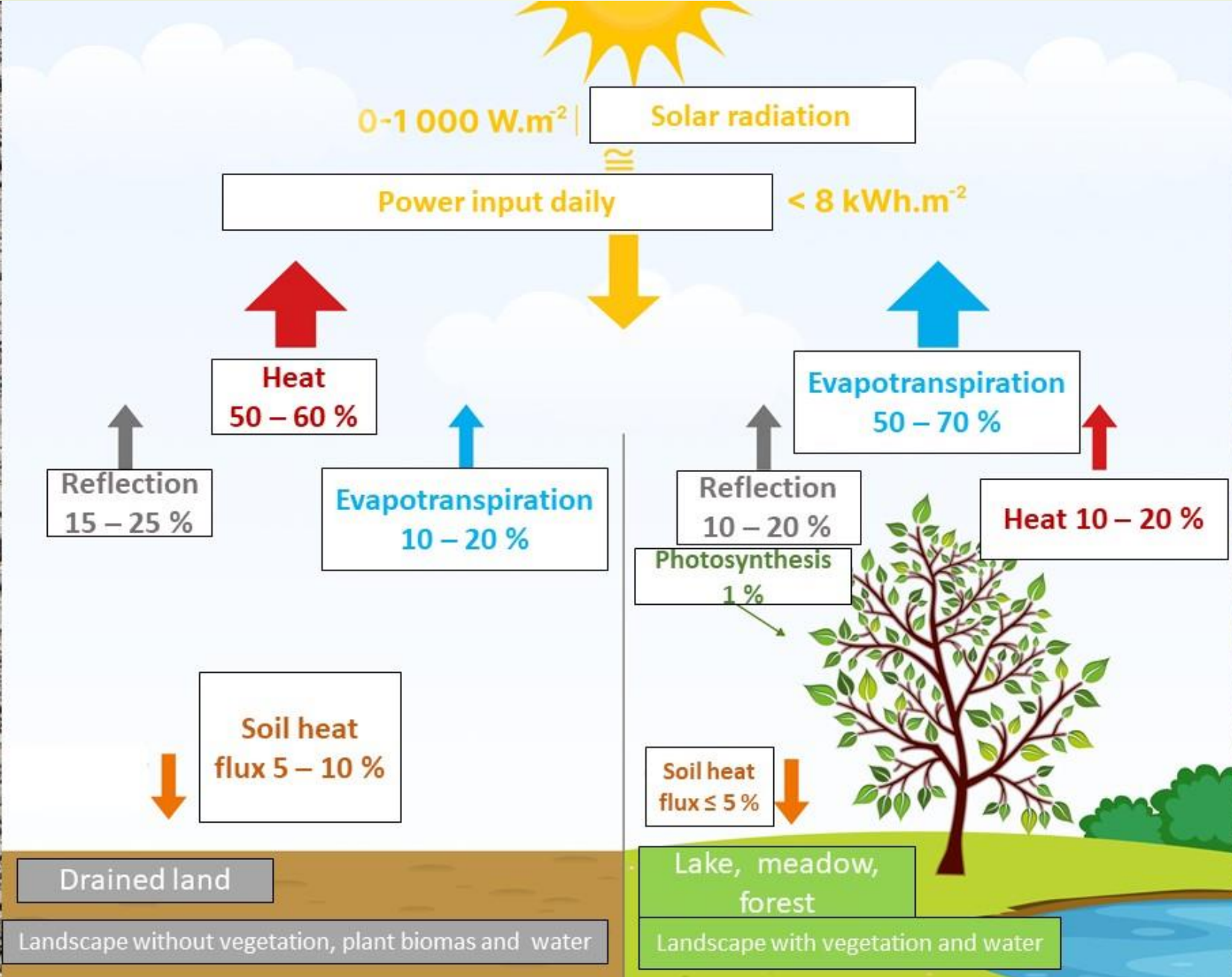
Inquiry based learning
Project based learning
STEM principle
Field measurements



Connection Solar energy-Vegetation - Water

- ▶ Water recycling via vegetation in the landscape is crucial for precipitation and accordingly a sufficient water supply (Sheil, 2018; Boyce and Lee, 2017)
 - ▶ Approx two-thirds of precipitation on land is caused by terrestrial vapour cycle (Dai and Trenberth, 2002)
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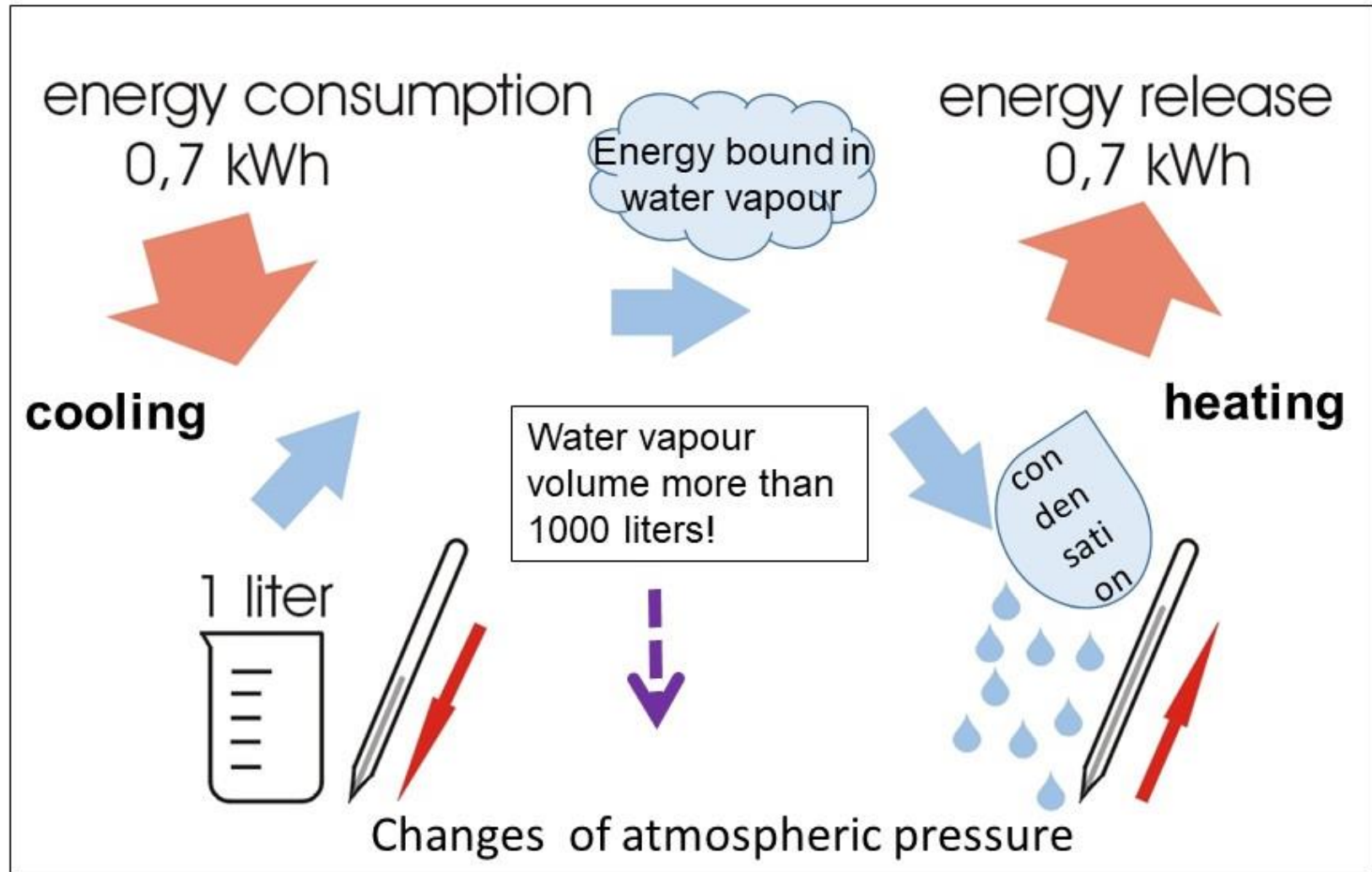
The role of vegetation in solar energy distribution and water cycle*



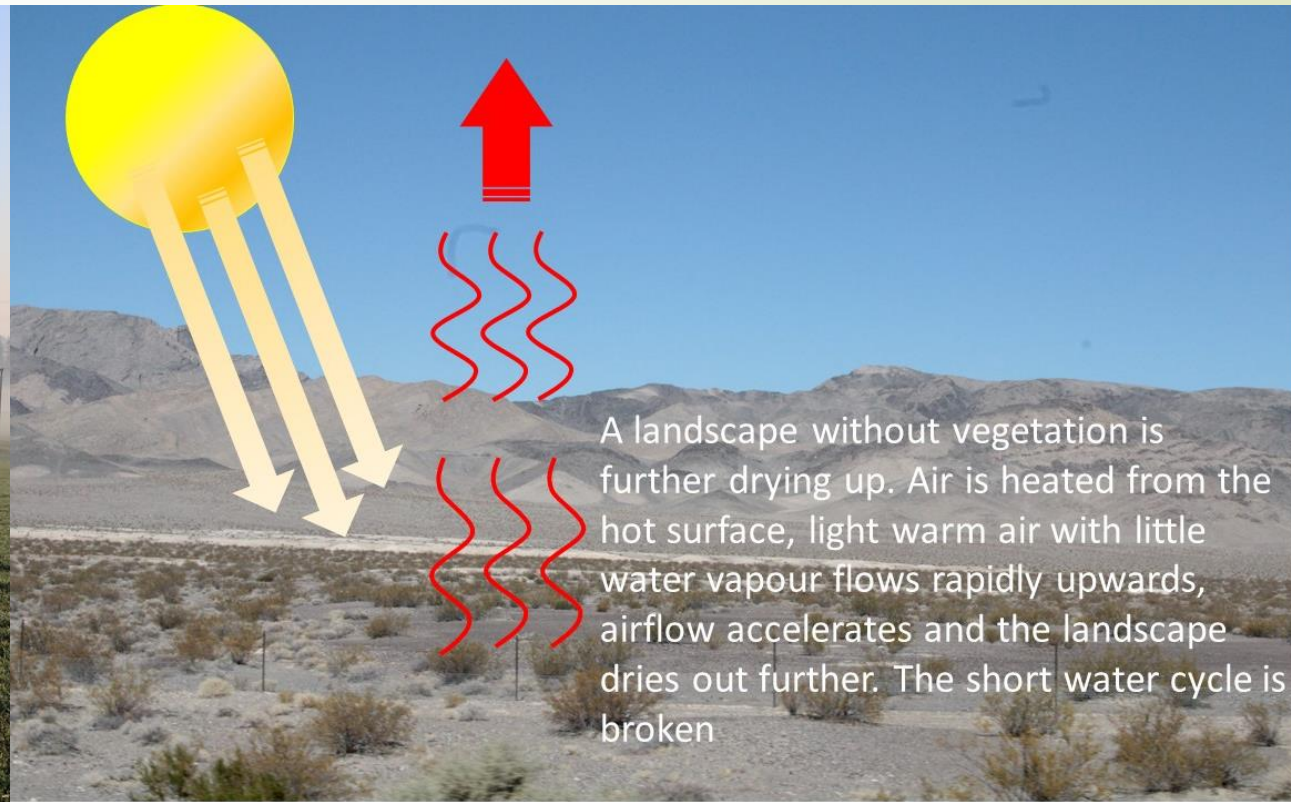
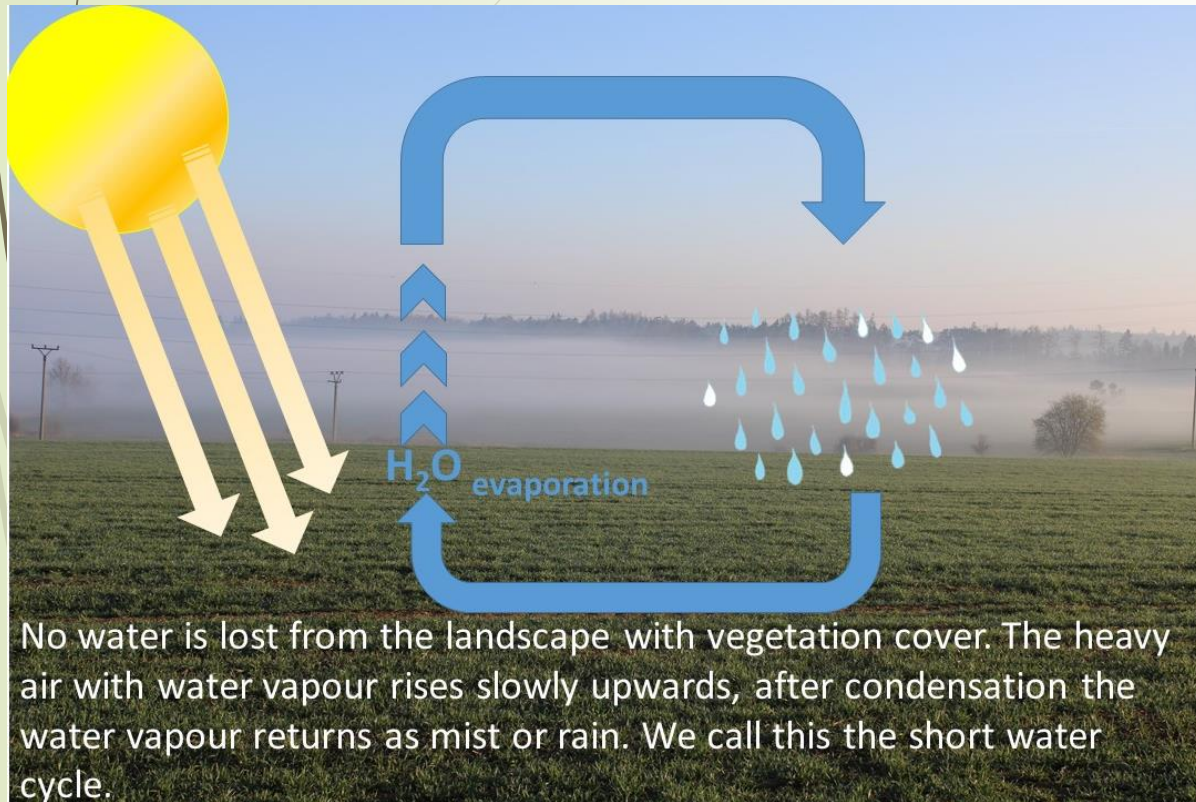
* Simplified scheme - long wave radiation/heat to atmosphere which is on sunny day about $100\text{W}/\text{m}^{-2}$ is not included

Latent heat is used for water vapour and released by condensation

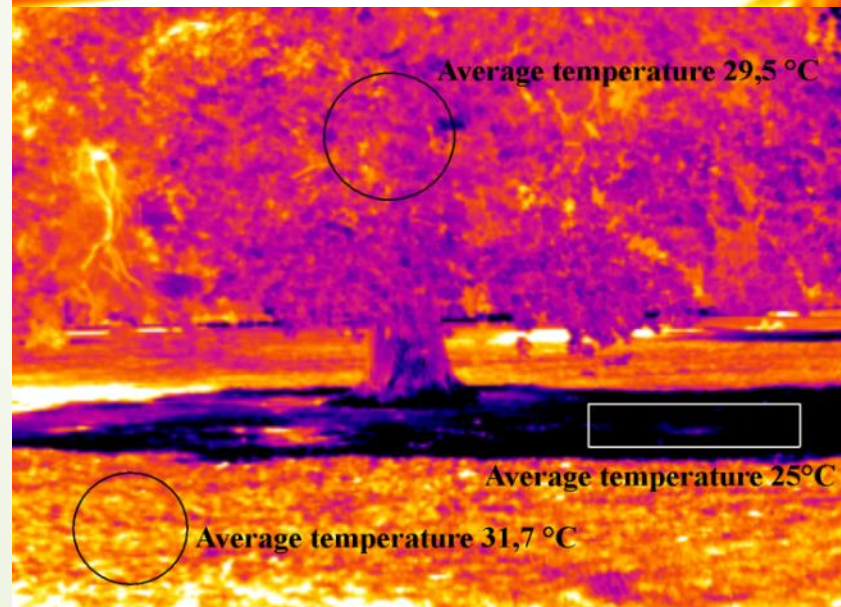
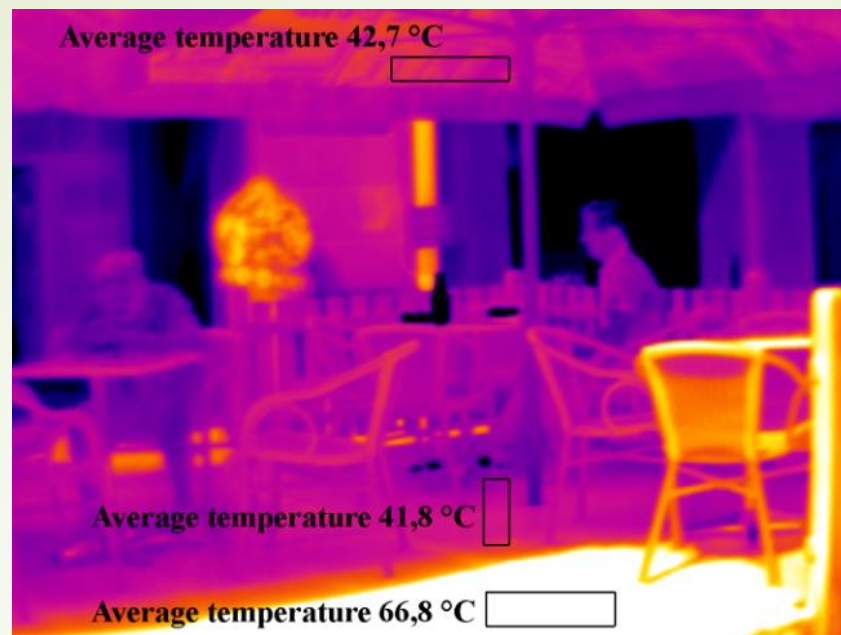
How
does it
work?



Plants ensure water retention in the landscape via short water cycle



Why is the shadow of a tree collar than the shadow of an umbrella?

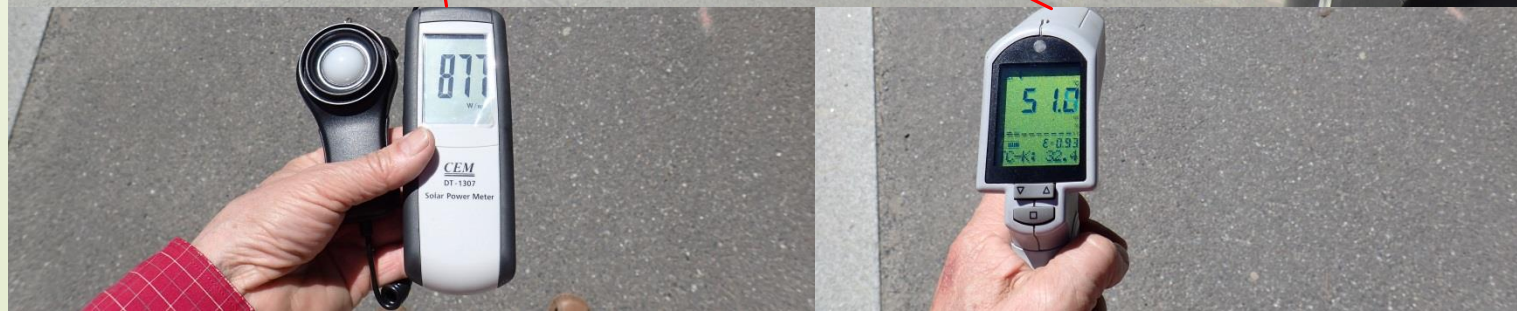


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Makarieva, A.M., Gorshkov, V.G. (2007) Biotic pump of atmospheric moisture as driver of the hydrological cycle on land. *Hydrol Earth Syst Sci* 11(2), 1013–1033.



877 W/m²
51 °C



Fotosyntéza
0,2kW





Misconceptions discovered in previous surveys done at Czech basic and secondary schools:

- ▶ The only way how can vegetation impact our atmosphere is oxygen production!
- ▶ „Waste of water“ - Trees use too much water for their growth, better to cut them down!
- ▶ Plants use entirely the whole water absorbed by the roots, no water comes out of the plants!
- ▶ The most solar energy absorbed by vegetation is used for photosynthesis
- ▶ Transpiration vs. Respiration
- ▶ ...etc.

Field measurements using simple, cheap, modern measuring devices

Solar radiation **W/m²**



Thermocamera

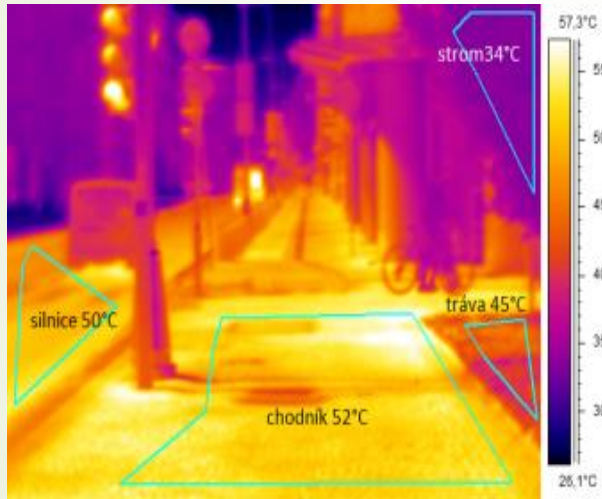


Surface temperature

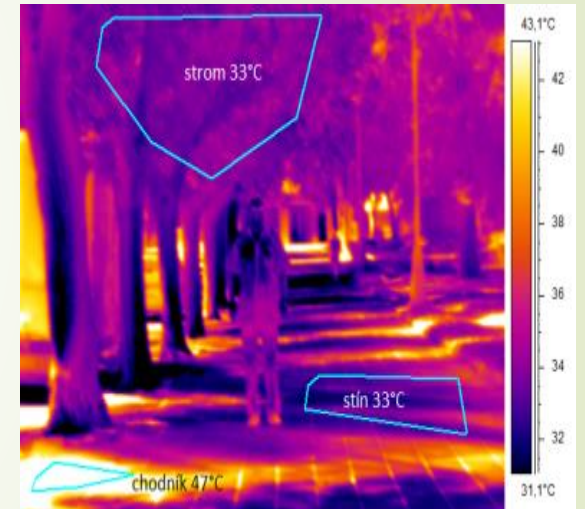


Thermovision

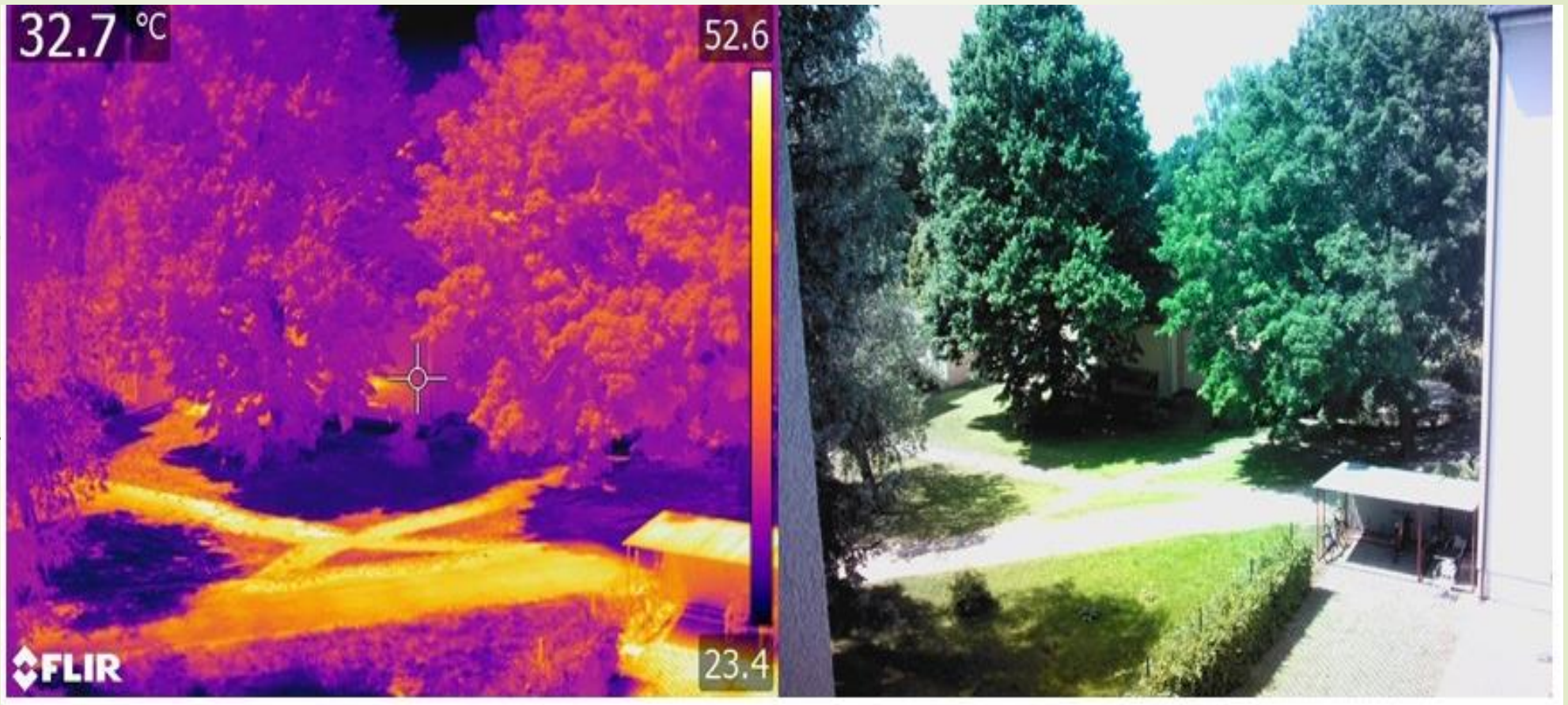
Street without trees on a summer day



Surface temperature of pavement 52 °C, a tree on a side 34 °C



Surface temperature of a pavement in tree shadow: 33 °C
Temperature of irradiated surface: 47 °C,.



Sources and recommended literature:

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The new teaching methodology for pre-service teachers of biology in Czech:
<https://projekty.pf.jcu.cz/svv/>

New teaching activities based on this methodology
will be available in 2024 in English at:

<https://planteducation.eu/>





Thank you for your attention !

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