

Delovni sklop 4: Model razvoja smrekovih podlubnikov in sistem obveščanja

Aktivnost 4.4: Spremljanje temperature zraka in temperature skorje

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REPUBLIKA SLOVENIJA
MINISTRSTVO ZA KMETIJSTVO,
GOZDARSTVO IN PREHRANO



Javna agencija
za raziskovalno dejavnost
Republike Slovenije

Aktivnost 4.4: Spremljanje temperature zraka in temperature skorje

Cilj spremljanja temperature zraka in skorje je izdelati regresijski model med temperaturo zraka in temperaturo skorje na različnih nadmorskih višinah, ekspozicijah in mikrolokacijah na kontrolno-lovnih deblih (KLD).

Za napovedni model razvoja smrekovih podlubnikov bomo nato, preko temperature zraka (podatki ARSO iz sistema INCA), modelirali temperaturo skorje.

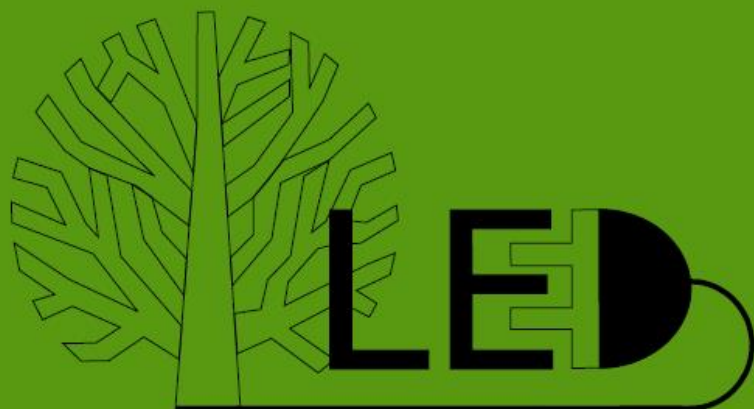
Usmeritve: Temperatura zraka se bo avtomatsko odčitala vsako uro in shranila v napravi oz. avtomatsko poslala posnete podatke s pomočjo GPRS signala na FTP strežnik. Na vsakem kontrolno-lovnem deblu bomo merili temperaturo skorje vsako uro na štirih mestih: zgoraj, spodaj, levo in desno. Termometre za merjenje temperature skorje bomo namestili na dnu krošnje.

Rezultat aktivnosti: Temperatura zraka in temperatura skorje KLD izmerjena vsako uro na *štirih* lokacijah v letih 2017 in 2018.



LABORATORY FOR ELECTRONIC DEVICES

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fax: +3861 257 35 89



Selected references

- ① The network of meteorological stations
- ① Eddy covariance towers
- ① Automated chambers for soil respiration monitoring
- ① Soil water content automated measuring systems for irrigation purposes
- ① Smart Irrigation Systems
- ① CO2 concentration profiles (caves, canopy level, mofette)
- ① Various Multiplexing Systems

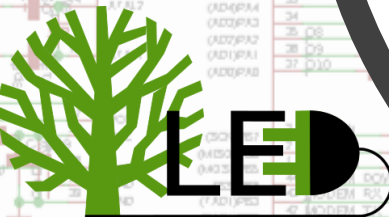
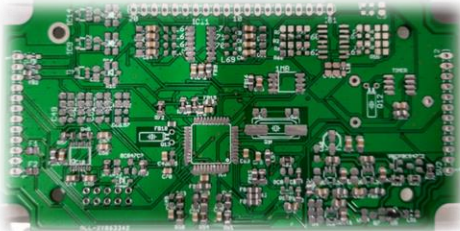
Patents

- ① A method for measuring the dynamics of root development and apparatus for carrying our said method: EP2289307
- ① Apparatus for capturing a gas flow: P2120602

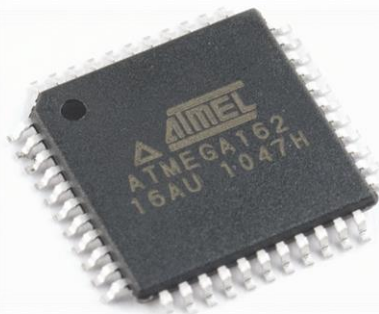
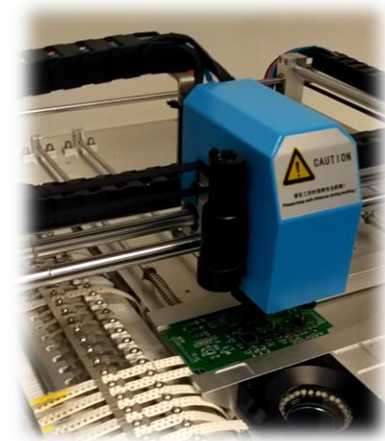
SLOVENIAN FORESTRY INSTITUTE



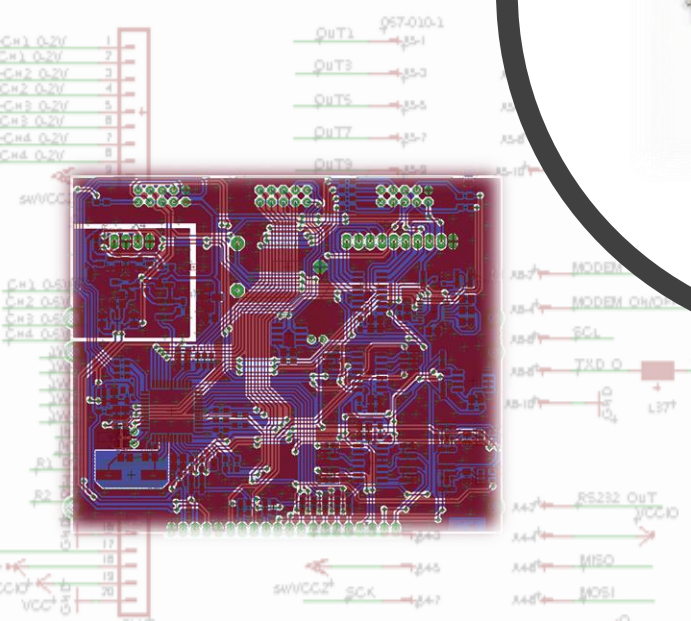
Merilno-shranjevalna naprava



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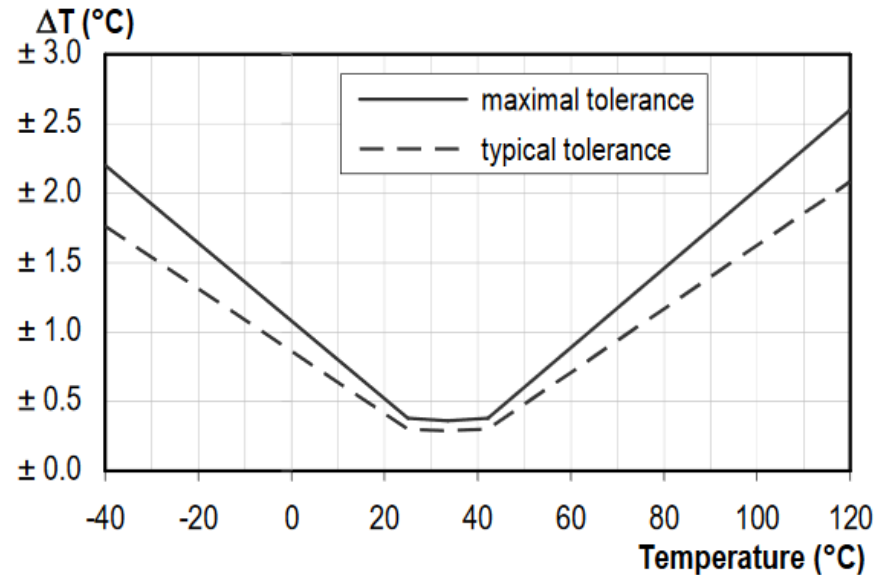
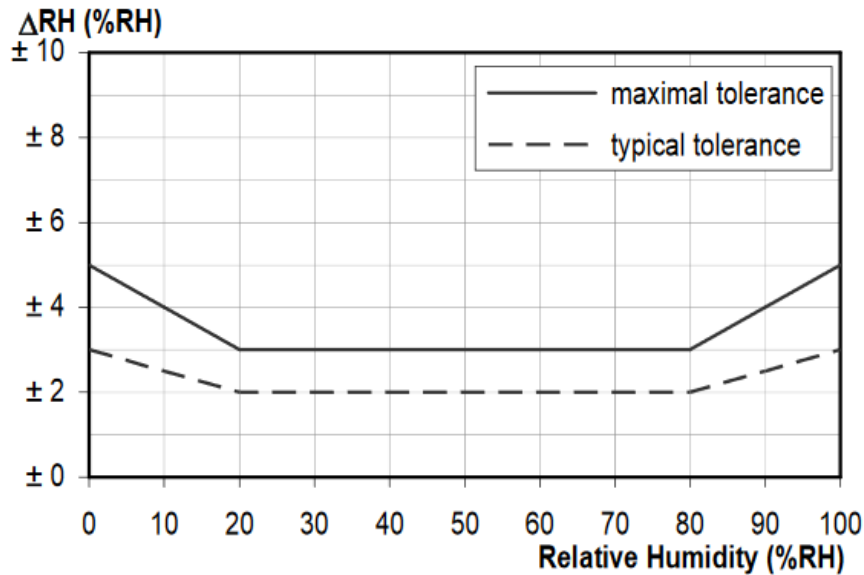


```
BASCOM-AVR IDE [2.0.8.0] - [C:\Users\mitga\OneDrive - Gozdarski inštitut Slovenije\mitga-  
File Edit View Program Tools Options Window Help  
IoTm_4V_P_pretok_ventil_v19bas  
Sub Label MCP  
'ugasnemo ledico  
PORTB.6 = 0  
Return  
Mcp:  
L_mesto = 0  
I = 0  
'Disable Interrupts  
M:  
Incr I  
I2cstart  
I2cwbyte Pisi  
I2cwbyte Ch  
I2cstop  
Waitms 80  
I2cstart  
I2cwbyte Beri  
I2crbyte Test_h , Ack  
I2crbyte Test_l , Ack  
I2crbyte L_mesto , Nack  
I2cstop  
'Print L_mesto ; " " ; Ch ; " " ; I  
If L_mesto <> Ch And I < 4 Then  
Goto M  
Elseif I >= 4 Then  
Test_h = 255  
Test_l = 255  
End If  
'Enable Interrupts  
Reset Watchdog  
Return
```



Vlaga in temperatura zraka

SENSIRION
THE SENSOR COMPANY



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Temperatura skorje

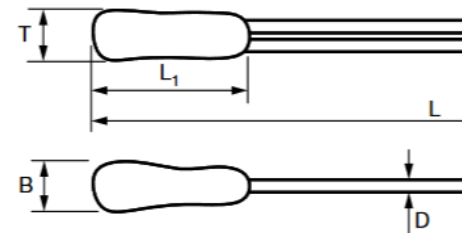


www.vishay.com

NTC Thermistors



DIMENSIONS in millimeters



T _{MAX.}	B _{MAX.}	L	L ₁
1.6	1.6	41.0 ± 1	5.0 ± 1



www.vishay.com

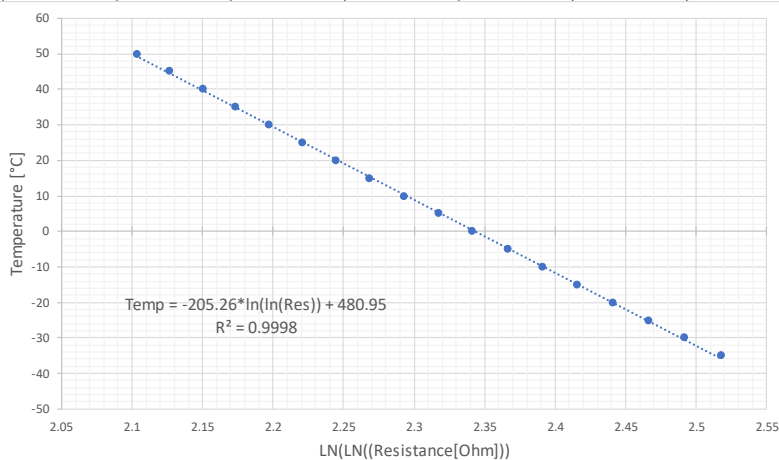
NTCLE305E4...SB

Vishay BCcomponents

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R₂₅ AT 10 kΩ

SAP PART AND ORDERING NUMBER: NTCLE305E4103SB(A)

TEMPERATURE (°C)	RESISTANCE (Ω)	R/R ₂₅	ΔR/R (%)	α (%/K)	ΔT _{MAX.} (± °C)	R _{MIN.} (Ω)	R _{MAX.} (Ω)
-40	334 274	33.427	4.10	-6.63	0.62	320 580	347 969
-35	241 323	24.132	3.91	-6.41	0.61	231 879	250 767
-30	176 133	17.613	3.74	-6.19	0.60	169 549	182 716
-25	129 900	12.990	3.57	-5.99	0.60	125 264	134 536
-20	96 761	9.6761	3.41	-5.79	0.59	93 465	100 058



prosimo, da eksperiment ne motite.
no je dotikanje in premikanje merilnih na

e dodatne informacije smo vam na voljo:

dr. Nikica Ogris, tel. (01) 200 78 33

Marija Kolšek, tel. (01) 470 00 77

prof. dr. Maja Jurc, tel. (01) 320 35 34

Izvajal delovnega sklopa 4:

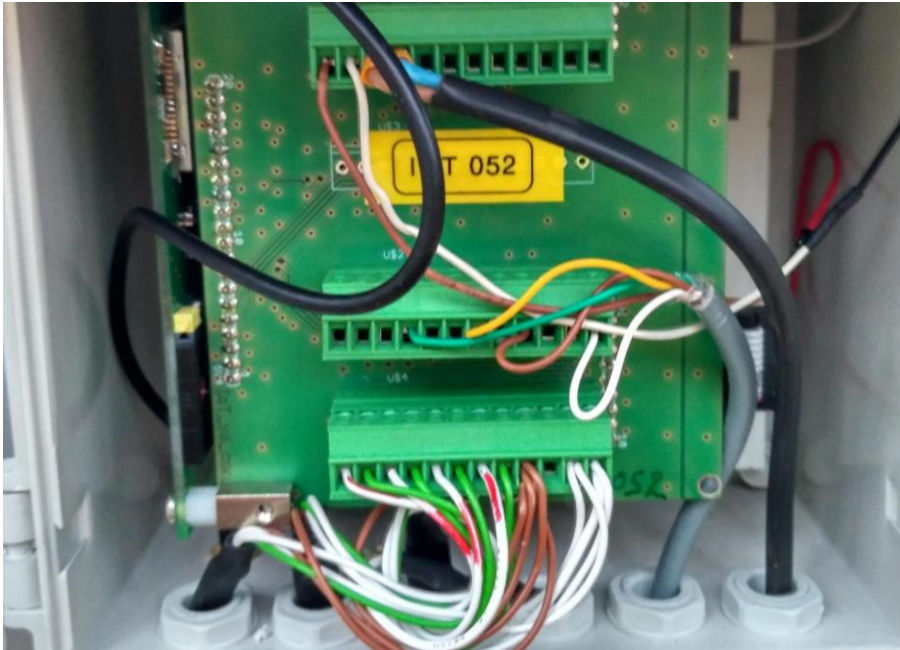
Inštitut Slovenije, 7. vod za gozdove Slovenije
tehniška fakulteta, Oddelek za gozdarstvo



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Izvedba meritev vsakih 30 minut





Merilno-shranjevalna naprava z modemom

sftp://eemis@193.2.23.31 - FileZilla

Datoteka Uredi Pogled Prenesi Strežnik Zaznamki Pomoč

Na voljo je nova različica!

Uporabniško ime: Geslo:

tanje: Pridobivanje seznama mape »/home/archive/program/fail/len« ...
 tanje: Listing directory /home/archive/program/fail/len
 tanje: Pridobivanje seznama mape »/home/archive/program/fail/len« uspešno

Krajevni strežnik:	Oddaljeni naslov:
C:\Users\mitja\OneDri	hive/program/fail/len

Ime datoteke	Ime datoteke
137 datotek. Skupna velikost: 2,957,704,761 baj	Izbrana 1 datoteka. Skupna velikost: 226 baj

Strežnik/krajevna datoteka	Smer	Oddajena datoteka	Veliko
Datoteka v vrsti za prenos			

eEMIS

Data Summary : CRP Podlubniki - Medvedica - 466 mnv
01.03.2017 01:00:00 - 17.08.2017 10:00:00

Parameters	MIN	AVG	MAX	SUM	Statistic
Battery voltage	3.71V DC	4.05V DC	4.17V DC		99.95%
GPRES signal	10	23	28		99.95%
Relative humidity	25.64%	78.95%	97.70%		99.95%
Air temperature	-1.71°C	14.45°C	31.40°C		99.95%
Temperature	-2.63°C	13.88°C	31.15°C		99.95%
Temperature 1	-21.10°C	14.24°C	45.73°C		99.95%
Temperature 2	-2.38°C	14.28°C	44.83°C		99.95%
Temperature 3	-2.93°C	13.53°C	30.75°C		99.95%

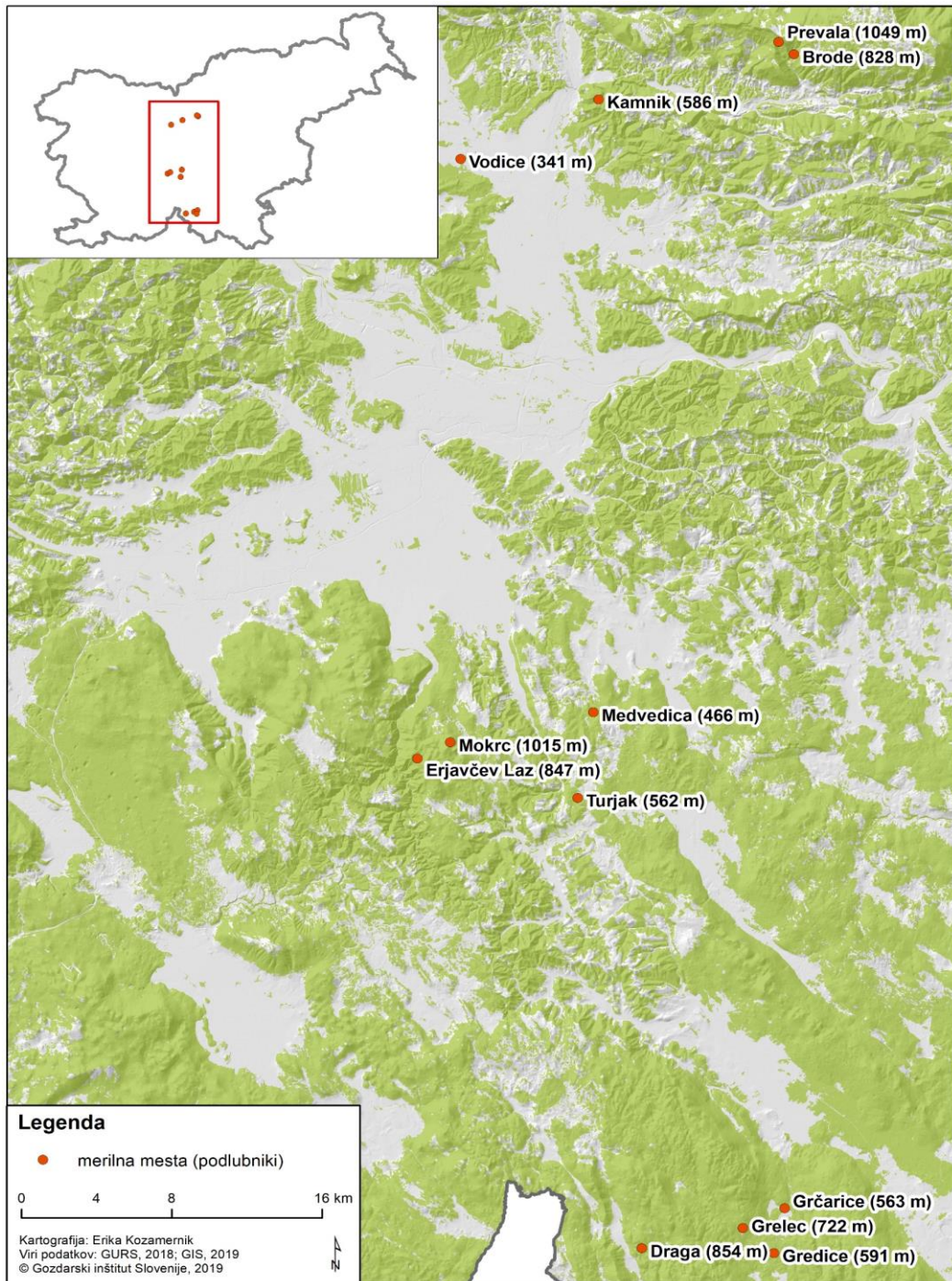
Data: CRP Podlubniki - Medvedica - 466 mnv
01.03.2017 01:00:00 - 17.08.2017 10:00:00

Battery voltage (V) chart showing a peak at 4.17V DC.



Nadmorska Višina [m]	Lokacija	2017												2018											
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
341	Vodice	99.97%																							
466	Medvedica													99.70%											
562	Turjak													99.63%											
563	Grčarice													100%											
586	Kamnik	98.36%																							
591	Gredice													100%											
722	Grelec													100%											
828	Brode	99.97%																							
847	Erjavčev Laz													99.95%											
854	Draga													97.40%											
1015	Mokrc													99.91%											
1049	Prevala	99.76%																							





Rezultati

Lokacija	Temperatura zraka [°C]			Temperatura skorje [°C]		
	Mnimum	Povprečje	Maksimum	Mnimum	Povprečje	Maksimum
Vodice	-1.7	15.2	31.4	0.4	14.8	38.1
Medvedica	-2.1	15.4	26.5	-3.0	15.0	27.4
Turjak	-3.7	14.5	27.3	-4.6	14.0	28.1
Grčarice	2.5	11.4	23.7	-5.1	2.8	13.9
Kamnik	-0.4	13.2	27.6	0.3	12.9	28.1
Gredice	-1.3	3.9	13.0	-3.1	2.7	11.3
Grelec	-2.7	3.5	12.9	-3.7	2.5	12.7
Brode	-1.3	13.6	27.9	-1.0	13.2	29.2
Erjavčev Laz	5.6	14.5	24.2	5.2	15.6	36.4
Draga	2.8	10.5	24.9	-4.2	2.7	19.6
Mokrc	5.3	15.1	26.1	4.8	14.9	29.1
Prevala	-1.2	12.7	27.6	-0.6	13.1	31.2

Absolutne minimalne in maksimalne ter povprečne temperature v merjenem obdobju.

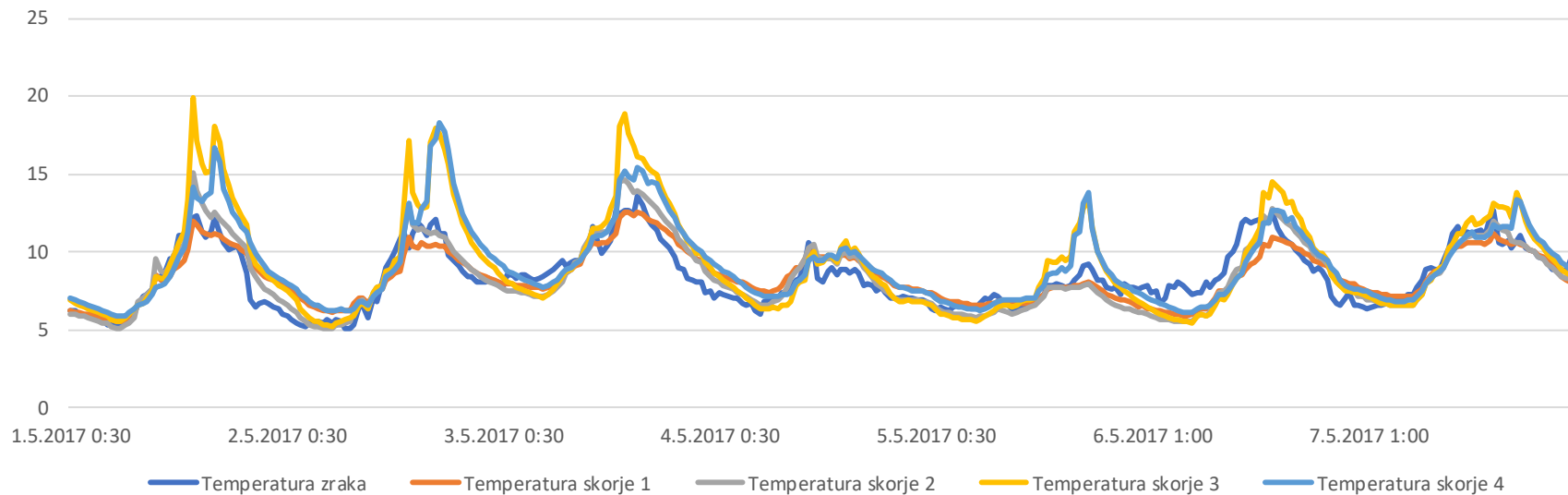


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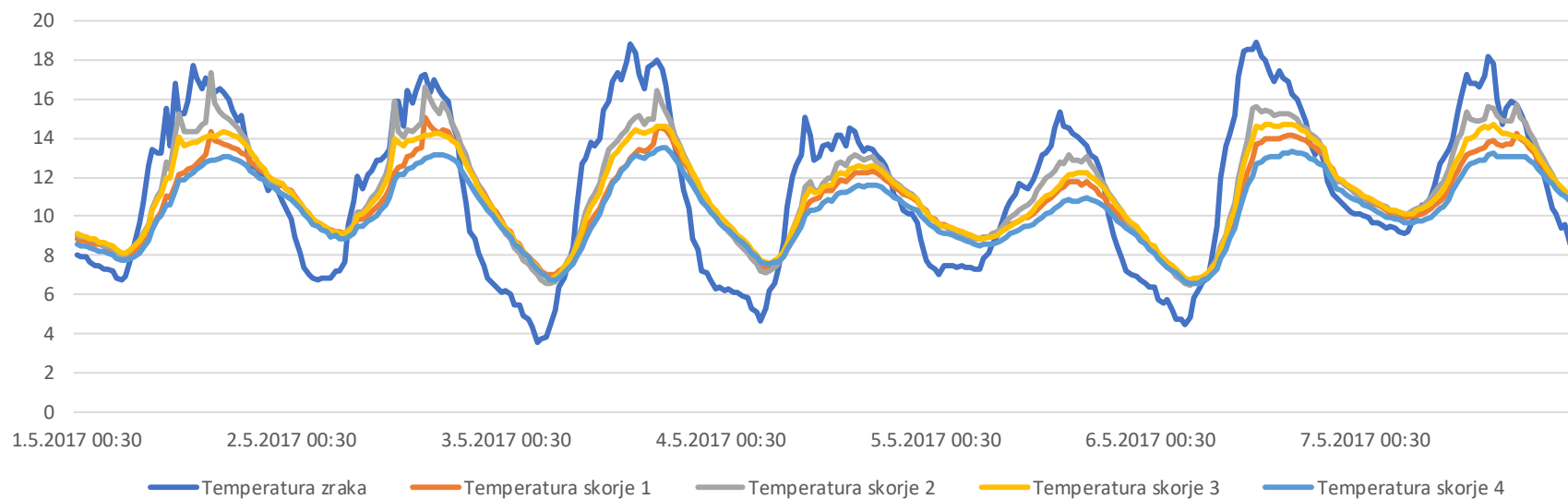


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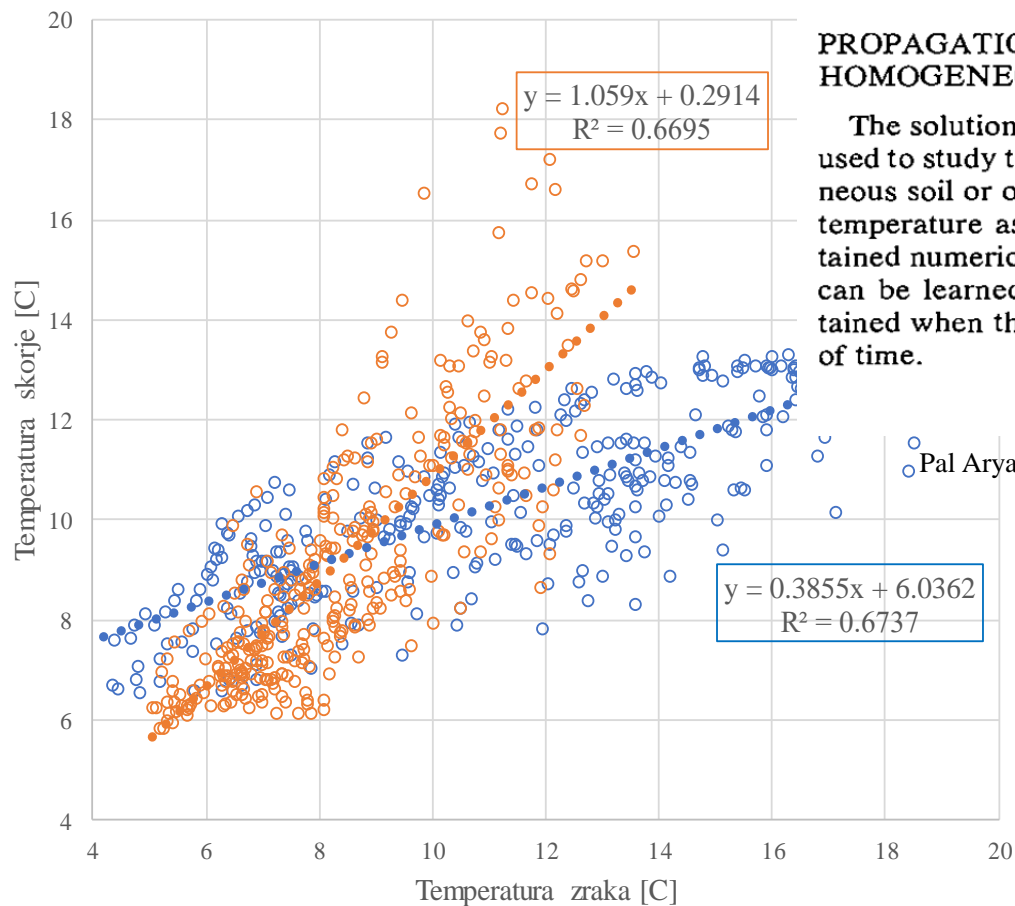
Prevala, 1.5.2017 do 7.5.2017



Vodice, 1.5.2017 do 7.5.2017



Prevala - oranžna, Vodice - modra



PROPAGATION OF THERMAL WAVE IN HOMOGENEOUS SOILS

The solution of Eq. (4.3), with given initial and boundary conditions, is used to study theoretically the propagation of thermal waves in a homogeneous soil or other submedium. For any arbitrary prescription of surface temperature as a function of time, the solution to Eq. (4.3) can be obtained numerically. Much about the physics of thermal wave propagation can be learned, however, from a simple analytic solution which is obtained when the surface temperature is specified as a sinusoidal function of time.

$$T_s = T_m + A_s \sin[(2\pi/P)(t - t_m)] \quad (4.5)$$

Pal Arya, S., 1988. Introduction to Micrometeorology. Academic Press, London.





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**HVALA ZA
POZORNOST**