Workshop – Smart technologies for sustainable agriculture

Round table “Digitization in Agriculture”

Sensory Monitoring and Modeling of Temporal and Spatial Phenomena in Agroecosystems

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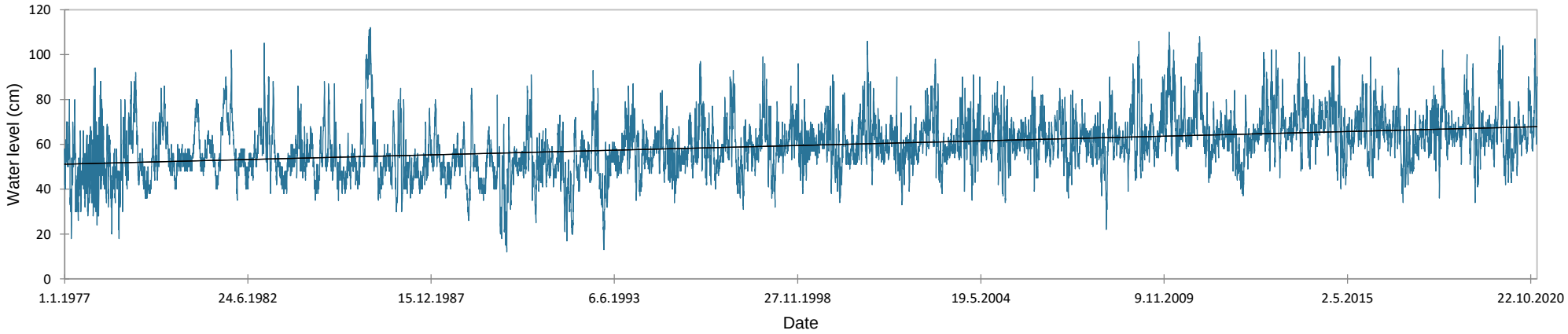
Sea level rise

- Global problem – up to 5 mm per year in the Mediterranean (Marcos and Tsimplis, 2008; IPCC)
- Special threat to river delta, especially karst area - Neretva delta

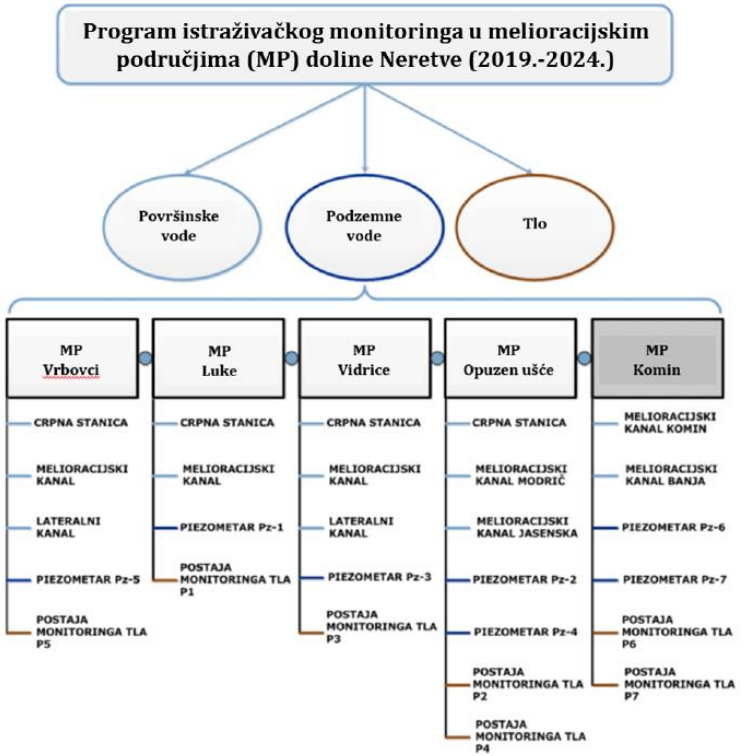
Data from the mareographer at the mouth of the Mala Neretva River



- Sea water intrusion – salinization of surface and groundwater
- Soil salinization → soil degradation → soil desertification

Monitoring water quality

- Of global and local importance – legally regulated
- Water Framework Directive (EC/2000/60) and water Act (OG 66/19)
- Since 2009, a research monitoring of surface and groundwater salinity and agricultural soil has been established in the Neretva River Valley area



Sensor *in situ monitoring* systems

- Classical monitoring – reliable but demanding
- Automatic, continuous, *in-situ* sensor systems
- Commercial sensors and probes
- Development of *in situ* smart water quality monitoring systems

Multi-parameter probe

Source: www.aquaread.com

Water quality prediction models

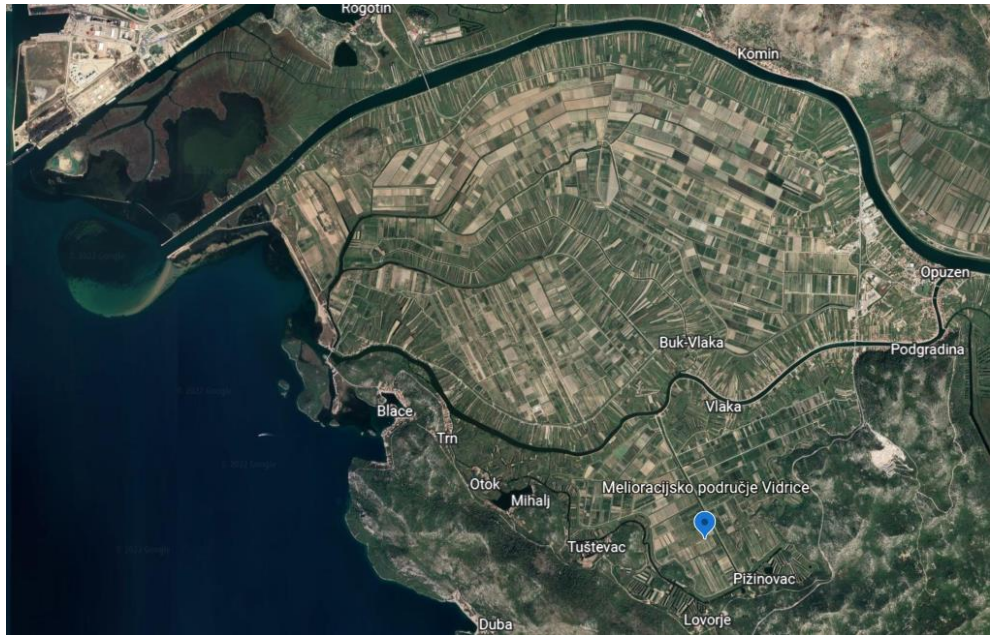
- Time series models – ARIMA model
- Machine learning models - multiple linear regression

  - nonlinear regression

  - artificial neural networks

The case of the Lower Neretva Valley

- hydro –ameliorated area of Vidirce



Source: Google Earth (27.6.2022)

- hydro –ameliorated area of Luke

Source: Google Earth (27.6.2022)

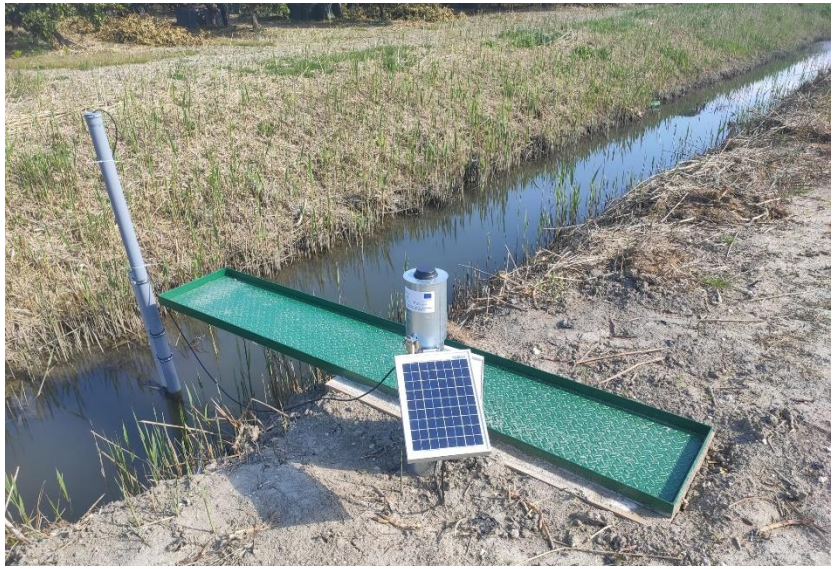
Setting the facilities and systems

- Preparation of locations for installation of multi-parameter probes (MPP) for monitoring of physical-chemical indicators of surface and groundwater
  - Surface waters (melioration canal) — installation of a structure for the installation of MPP

  - Groundwater — drilling of shallow piezometers 4 m deep and 110 mm profile

Water salinity monitoring with multi-parameter probes

MPP — surface water



MPP — ground water

Data collection and transmission modem

Water quality parameters

Multi-parameter probes installed in surface and groundwater

- Depth of water (m)
- Water temperature (°C)
- Electrical conductivity (EC $_w$) (dS/m)
- pH
- Total dissolved dry matter (TDS) (mg/l)
- Salinity (PSU)
- Specific sea water density (σT)
- Resistance (Ω cm)

Hourly time resolution

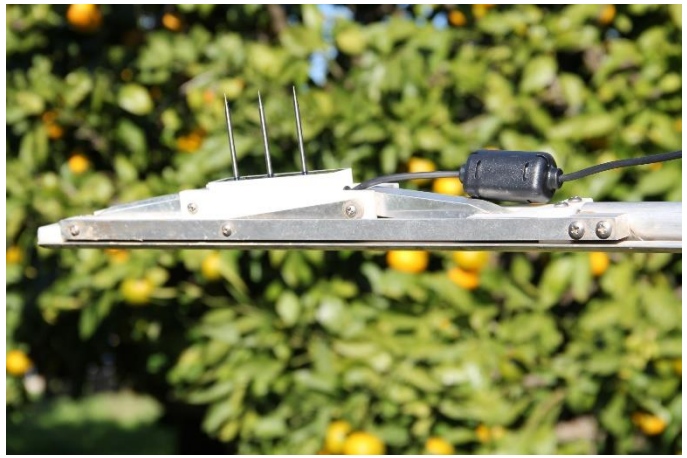
Soil salinity monitoring with sensors

Installed soil sensors

- Soil temperature (°C)
- Moisture content in the soil (m^3/m^3)
- Electrical conductivity (µs/cm)

Ten minutes time resolution

Soil sensor



Installed soil monitoring system

Logger for data collection and transmission

Meteo-data collection

Meteorological station installed

- Air temperature (°C)
- Relative humidity of air (%)
- Wind speed (m/s)
- Global radiation (W/m ^{2})
- Precipitation (mm)

Ten minutes time resolution

Meteorological station

Collected data

- **Classical monitoring** - 24 data can be collected for each indicator in two years of research

- ***In-situ* sensor monitoring** – over 17,000 data per indicator (parameter) collected in hour resolution i and over 150,000 data collected in ten minute resolution

- collected almost 7,9 million data so far – **open data**

Statistical data processing and modelling

- **Correlation analysis** of all measured indicators
- **Analysis of time series —** structure and characteristics of data
- **Predictions of the degree of salinity -** time series models and machine learning models based on linear regression

Expected contribution of the project

Detailed insight into the dynamics of water and soil salinization – anthropogenic and natural processes

Development of a model for precise short-term prediction of the degree of salinization of surface and groundwater

Guidelines for planning future water and soil management

Who can use these data?

- **Farmers - irrigation planning and water quality control**
- Authorities responsible for land and water managment, agricultural production
- Research and education

DeltaSal

portal.deltasal.hr/#/KartaLokacija

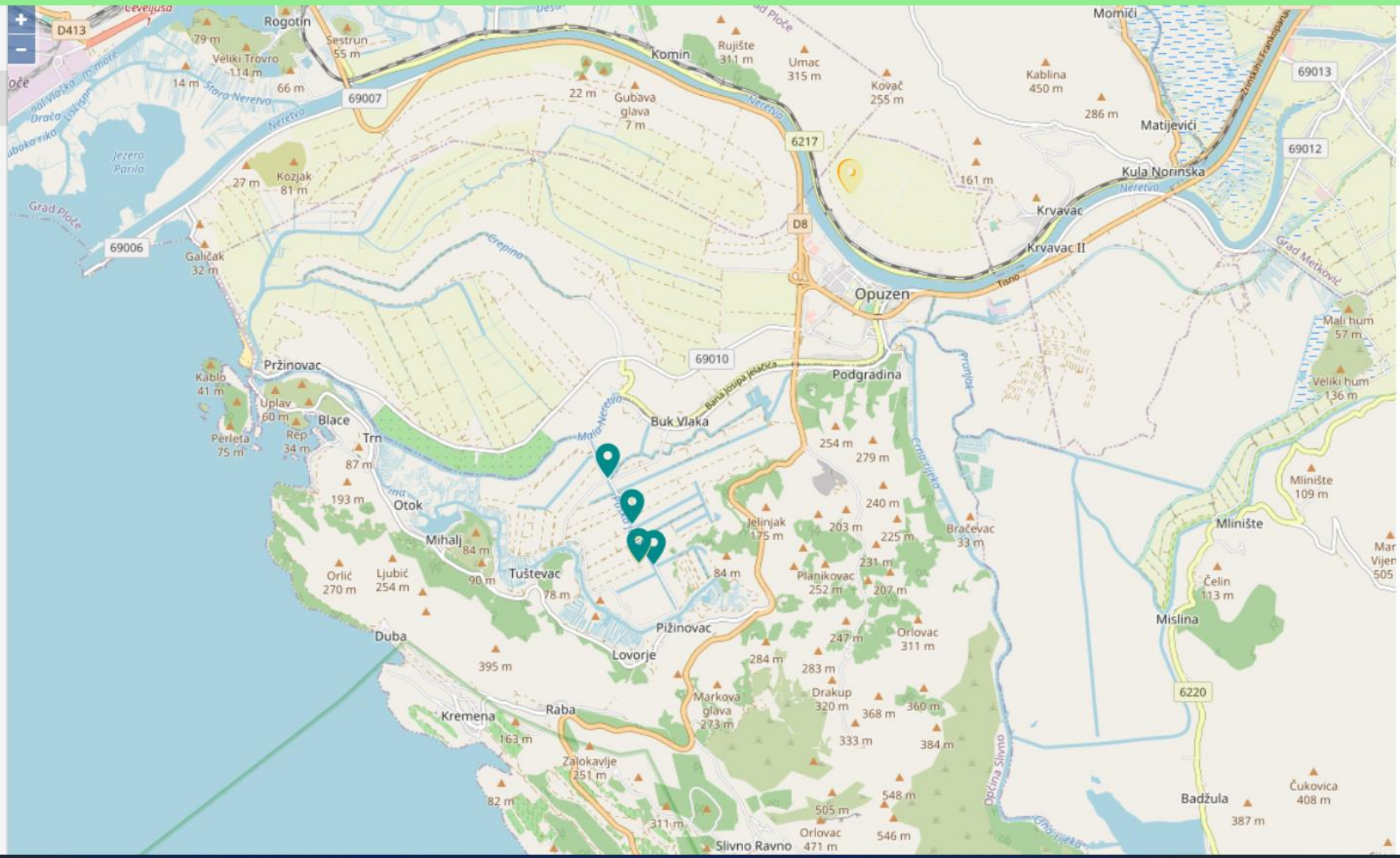
Karta lokacija

hr

Marko Reljić

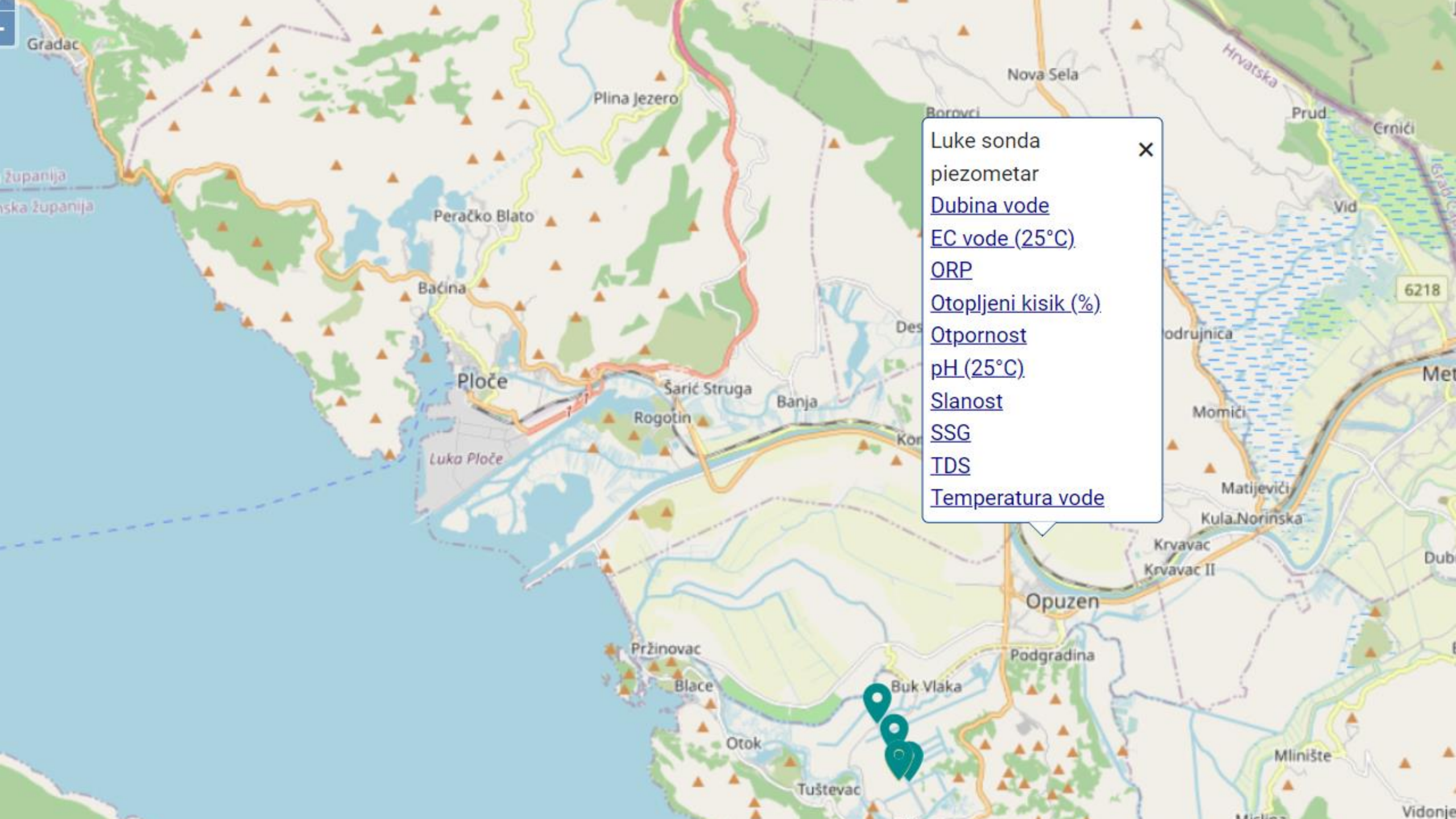
Odjava

- Naslovnica
- Karta lokacija
- Lokacije
- O programu



60°F
Cloudy

20:30
19.10.2022.


Luke sonda
piezometar
Dubina vode
EC vode (25°C)
ORP
Otopljeni kisik (%)
Otpornost
pH (25°C)
Slanost
SSG
TDS
Temperatura vode
Gradac
Plina Jezero
Nova Sela
Hrvatska
Prud
Crnići
Vid
Peračko Blato
Bačina
Ploče
Šarić Struga
Rogotin
Banja
Luka Ploče
Momići
Matijevići
Kula Norinska
Krvavac
Krvavac II
Opuzen
Podgradina
Pržinovac
Blace
Buk Vlaka
Otok
Tuštevac
Mlinište
6218

DeltaSal

portal.deltasal.hr/#/Karta?t=1666203952722

Graf

Od
01.01.2022.

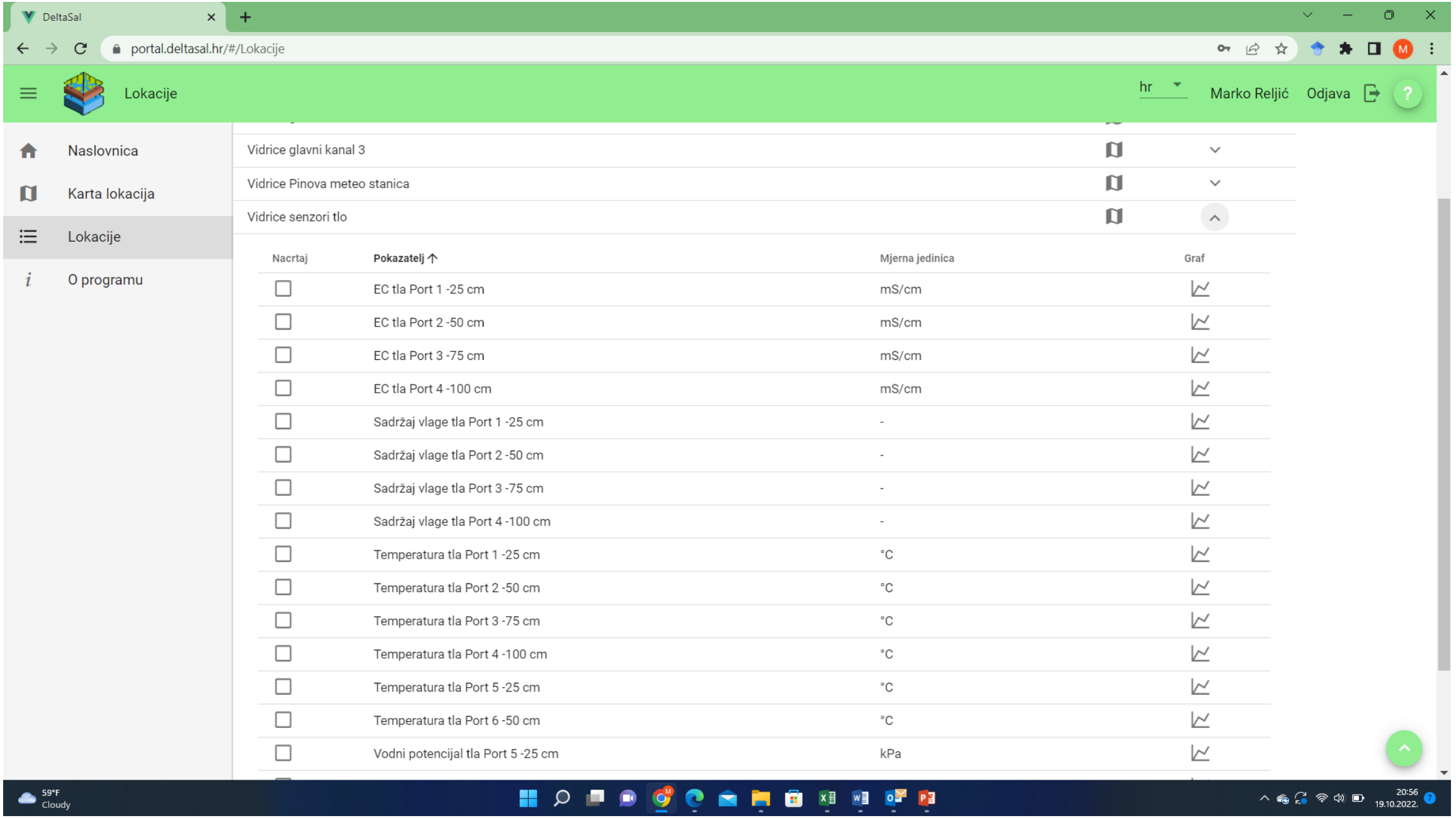
Do
19.10.2022.

10' h d

Prikaži

60°F Cloudy

20:28 19.10.2022.


DeltaSal
portal.deltasal.hr/#/Lokacije
Lokacije
hr
Marko Reljić
Odjava
Naslovnica
Karta lokacija
Lokacije
O programu
Vidrice glavni kanal 3
Vidrice Pinova meteo stanica
Vidrice senzori tlo
Nacrtaj
Pokazatelj
Mjerna jedinica
Graf
EC tla Port 1 -25 cm mS/cm
EC tla Port 2 -50 cm mS/cm
EC tla Port 3 -75 cm mS/cm
EC tla Port 4 -100 cm mS/cm
Sadržaj vlage tla Port 1 -25 cm -
Sadržaj vlage tla Port 2 -50 cm -
Sadržaj vlage tla Port 3 -75 cm -
Sadržaj vlage tla Port 4 -100 cm -
Temperatura tla Port 1 -25 cm °C
Temperatura tla Port 2 -50 cm °C
Temperatura tla Port 3 -75 cm °C
Temperatura tla Port 4 -100 cm °C
Temperatura tla Port 5 -25 cm °C
Temperatura tla Port 6 -50 cm °C
Vodni potencijal tla Port 5 -25 cm kPa
59°F
Cloudy
20:56
19.10.2022.

DeltaSal

portal.deltasal.hr/#/Lokacije

Graf

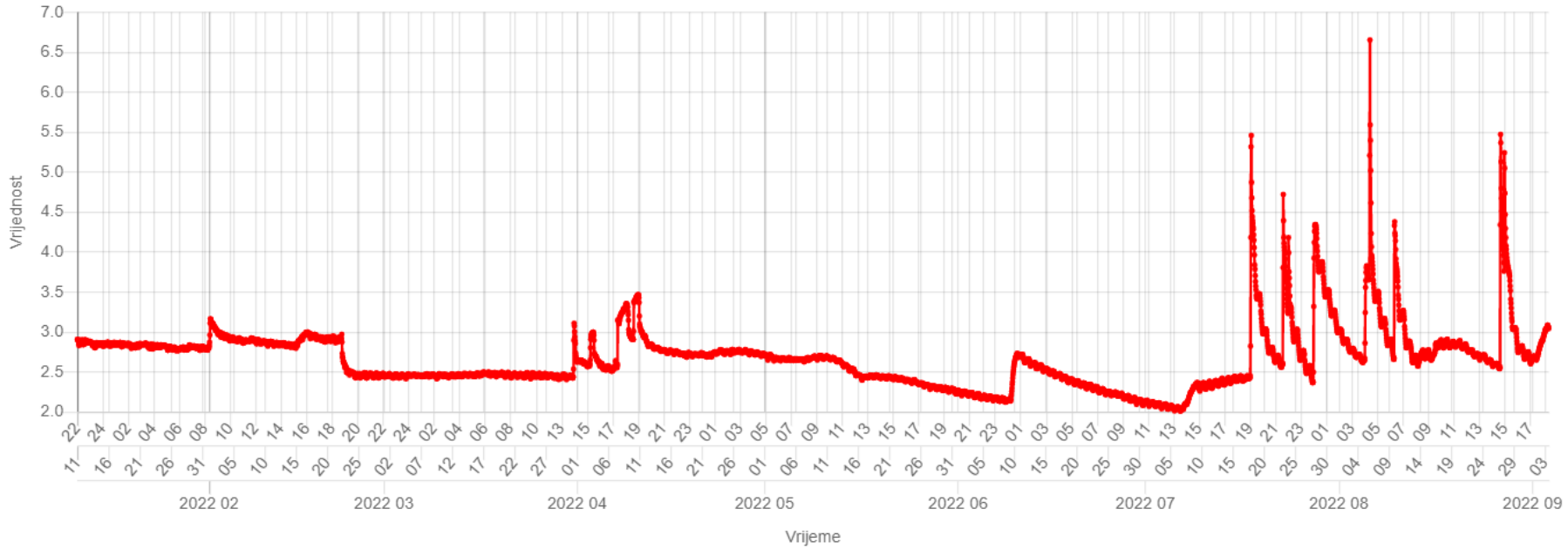
Od
01.01.2022.

Do
19.10.2022.

10' h d

Prikaži

Vidrice senzori tlo EC tla Port 1 -25 cm [mS/cm] - 6975 t.



59°F Cloudy

21:01 19.10.2022.

Naslovnica
Karta lokacija
Lokacije
O programu

Vidrice glavni kanal 1

Vidrice glavni kanal 2

Vidrice glavni kanal 3

Vidrice Pinova meteo stanica

Nacrtaj	Pokazatelj ↑	Mjerna jedinica	Graf
☐	Brzina vjetra	m/s	
☐	Globalno zračenje	W/m^2	
☐	Maksimalna brzina vjetra	m/s	
☐	Oborine	l/m^2	
☐	Relativna vlažnost zraka	%	
☐	Temperatura tla	°C	
☐	Temperatura tla	°C	
☐	Temperatura zraka	°C	
☐	Vlažnost lista	%	
☐	Vlažnost tla	cb	

Vidrice senzori tlo

Vidrice sonda kanal

Vidrice sonda piezometar

Vidrice sporedni kanal 1

Thank you for your attention!

REPUBLIKA HRVATSKA
Ministarstvo regionalnoga razvoja
i fondova Europske unije

REPUBLIKA HRVATSKA
Ministarstvo gospodarstva
i održivog razvoja

Projekt je sufinancirala Europska unija iz Europskog fonda za regionalni razvoj