



Training in Micrometeorological Measurements and Applications

COST FAIRNESS Summer School 2024

BUDAPEST, Hungary, June 10th – 15th, 2024

1117 Budapest Pázmány Péter s. 1/A,
North Building 1.71 Jenő Pócza Lecture hall



**Monday, June 10th – General information, Measurement techniques,
Teamwork**

ELTE, 1117 Budapest Pázmány Péter s. 1/A
North Building 1.71 Jenő Pócza Lecture hall

TEAMS Meeting: ID: 317 401 163 632 Passcode: RTRaT7n

Time	Lecturers / Trainers	Title / Content
9:00 – 9:30		Registration
Chair: Dr. Róbert Mészáros , Department of Meteorology, ELTE Eötvös Loránd University		
9:30 – 9:45	Prof. Imre Kacs Kovics , Dean, ELTE, Dr. Eszter Knyihár , International Strategy Office, ELTE Prof. Josef Eitzinger , Vice Chair of COST Action, BOCU Vienna	Opening Remarks
9:45 – 10:05	Dr. Ana Firanj Sremac , University of Novi Sad	Structure and development of FAIRNESS COST Action
10:05 – 10:40	Roland Steib , HungaroMet	Measuring networks, QC/QA system of HungaroMet
10:40 – 11:00	Prof. Zoltán Gribovszki , University of Sopron	Forest meteorological and hydrological measurements
11:00 – 11:20	Coffee break	
Chair: Prof. Levent Saylan , Department of Meteorological Engineering, Istanbul Technical University		
11:20 – 12:00	Dr. Erich Mursch-Radlgruber , BOKU, Austria	Meteorological stations, designs, sensors, applications (urban/rural)
12:00 – 12:25	Dr. Zoltán Istenes , ELTE Faculty of Informatic	Data collection, IT background, telecommunications
12:25 – 12:45	Dr. Róbert Mészáros , ELTE Department of Meteorology	Mobile measurements in Department of Meteorology, case studies
12:45 – 13:00	Dr. Tamás Weidinger , ELTE Department of Meteorology	Structure of the teamwork's
13:00 – 14:00	Lunch break	
14:00 – 15:20	Group leaders	Teamwork
15:20 – 15:40	Coffee break	
15:40 – 17:00	Group leaders	Teamwork
17:00 – 18:15	Dr. Tamás Weidinger , ELTE Met., Dr. István Szente , ELTE, Geol., Prof. Imre Salma , ELTE Chem.	Visit at the university: Mineral and rock exhibition (https://muzeum.elte.hu/), BpART Lab (http://salma.elte.hu/BpART/)

Tuesday, June 11 –Measurement techniques, Teamwork

ELTE, 1117 Budapest Pázmány Péter s. 1/A
North Building 1.71 Jenő Pócza Lecture hall

TEAMS Meeting: ID: 370 700 518 553 Passcode: FEcxRu

Chair: Dr. Erich Mursch-Radlgruber, BOKU, Austria		
9:00 – 9:50	Dr. Ana Firanj Sremac, University of Novi Sad	Agrometeorological field measurements: PIS agrometeorological network and data analysis
9:50 – 10:40	Prof. Josef Eitzinger, BOKU, Austria	The influence of microclimatic extremes on crops and how to manage it.
10:40 – 11:00	Coffee break	
11:00 – 12:00	Prof. Levent Saylan, Department of Meteorological Engineering, Istanbul Technical University	Determination of CO ₂ and H ₂ O fluxes in the terrestrial ecosystem by a micrometeorological method: <i>Measurement system design, data analysis</i>
12:00 – 12:20	Attila Viktor Kovács, HungaroMet, Miskolc	Agrometeorological service: Leaf wetness duration estimations
12:20 – 12:40	Dr. Tamás Gál, University of Szeged	Urban environment, green areas: measurements and modelling
12:40 – 13:00	Dr. Anita Erőss, ELTE Geology	Caves of Budapest: geology, microclimate and natural radioactivity measurements
13:00 – 14:00	Lunch break	
14:00 – 17:00	Group leaders	Teamwork: field measurements, data processing
19:00 – 21:30		Conference dinner with the PannEx annual meeting: A38 Restaurant (https://www.a38.hu/en/bistro)

Wednesday, June 12 – QC/QA, data management, gap filling

ELTE, 1117 Budapest Pázmány Péter s. 1/A
North Building 1.71 Jenő Póczy Lecture hall

[TEAMS Meeting](#): ID: 323 287 688 06 Passcode: sjJhhP

Chairs: Prof. Josef Etzinger, Erich Mursch-Radlgruber, BOKU, Austria		
9:00 – 10:00	Dr. Monika Lakatos, HungaroMet	High quality observational database on the open data portal of HungaroMet
10:00 – 10:50 (On line)	Prof. Branislava Lalic, University of Novi Sad	Quality control and gap filling for the micrometeorological measurements
10:50 – 11:10	Coffee break	
11:10 – 12:40	Dr. Ana Firanj Sremac, University of Novi Sad	Quality control and gap filling Lecture + practice Short examples in the ms. EXCEL
12:40 – 13:00	Prof. Levent Saylan, Department of Meteorological Engineering, Istanbul Technical University	Spatial quality control and gap filling methods in the terrestrial ecosystem measurements
	Lunch break	
14:00 – 17:00	Group leaders	Teamwork: field measurements, data processing

Thursday June 13 – HUN-REN Centre for Agricultural Research

Martonvásár <https://atk.hun-ren.hu/en/>

Program organisers:

Dr. Nándor Fodor, Hun-Ren Centre for Agricultural Research, Martonvásár

Dr. Ana Firanj Sremac, University of Novi Sad, Serbia

Dr. Tamás Weidinger, ELTE Department of Meteorology

9:17-9:36	Public train – Budapest, Kelenföld – Martonvásár	
Chair: Prof. Levent Saylan, Department of Meteorological Engineering, Istanbul Technical University		
10:00 –10:10	Dr. Nándor Fodor, Hun-Ren Centre for Agricultural Research, Martonvásár	History and main research directions of HUN-REN Centre for Agricultural Research
10:00 –10:50		Climate-smart and sustainable agriculture
10:50–11:40	Prof. Josef Etzinger, Erich Mursch-Radlgruber BOKU, Austria	How to monitor and forecast climatic and weather extremes for agrometeorological applications (risk warning)
11:40 – 12:00	Coffee break	
12:00 – 13:45	Dr. Nándor Fodor, Hun-Ren Centre for Agricultural Research, Martonvásár	Site visit: AgroMo – Climate and Environment Adaptive Decision Making Experimental Platform
13:45 – 14:30	Lunch break	
Afternoon	Agroversum (https://agroverzum.hu/en/), Optional teamwork in Martonvásár or Budapest	
	(16:18) (16:41) Public train – 16:48 Martonvásár – 17:11 Budapest, Kelenföld (17:18) (17:41)	



Friday, June 14 – Teamwork, FAIRNESS Mini-Conference

ELTE, 1117 Budapest Pázmány Péter s. 1/A
North Building 1.71 Jenő Póczy Lecture hall

[TEAMS Meeting](#): ID: 323 305 870 455 Passcode: iyCrKa

Chair: Dr. Ana Firanj Sremac, University of Novi Sad		
9:00 – 10:10	Dr. Pavol Nejedlik, Dr. Jan Hegyi Earth Science Institute of Slovak Academy of Sciences	Agrometeorology, phenology Regenerative agriculture
10:10 – 10:30	Coffee break	
10:30 – 12:00	Group leaders	Teamwork
12:00 – 12:10	ELTE and COST FAIRNESS representatives	Closing the summer school
12:10 – 13:00	Lunch break	
13:00 – 15:30	FAIRNESS Mini-Conference	
16:00 – 16:30	WG-Meeting (Educators and teamwork group leaders only)	

Saturday, June 15th 8:30 – 20:00

**Study tour by bus: *Bugac* (rural eddy covariance site),
Szeged (urban meteorology)**

Program organisers:

Dr. Tamás Gál, University of Szeged
Dr. Tamás Weidinger, ELTE Department of Meteorology
Dr. Ana Firanj Sremac, University of Novi Sad

Experts in field measurements:

Prof. Josef Etzinger, Erich Mursch-Radlgruber, BOKU, Austria
Prof. Levent Saylan, Department of Meteorological Engineering, Istanbul Technical University

**Local Organisation committee for
7th PannEx annual meeting and 3th COST FAIRNESS Summer School**

Dr. Rita Pongrácz, Dr. Tamás Weidinger,

Department of Meteorology, Institute of Geography and Earth Sciences,
ELTE Eötvös Loránd University, Budapest

Dr. Mónika Lakatos, HungaroMet

Dr. Nándor Fodor, Hun-REN Centre for Agricultural Research, Martonvásár

Dr. Tamás Gál, Department of Climatology and Landscape Ecology, University of Szeged

Prof. Imre Salma, Institute of Chemistry, ELTE Eötvös Loránd University, Budapest

Teamwork groups

Each group include 4-6 participants from different countries.

**We ask the participants of the working groups to bring their laptops
with them for easier work.**

Timetable for Teamwork groups

Monday, June 10th –Teamwork		
14:00 – 15:20	Group leaders	Teamwork
15:20 – 15:40	Coffee break	
15:40 – 17:00	Group leaders	Teamwork
Tuesday, June 11 –Teamwork		
14:00 – 17:00	Group leaders	Teamwork: field measurements, data processing
Wednesday, June 12 – Teamwork		
14:00 – 17:00	Group leaders	Teamwork: field measurements, data processing
Thursday June 13 – HUN-REN Centre for Agricultural Research, Martonvásár <i>https://atk.hun-ren.hu/en/</i>		
Afternoon	Agroversum (https://agroverzum.hu/en/), Optional teamwork in Martonvásár or Budapest	
Friday, June 14 – Teamwork, FAIRNESS Mini-Conference		
10:30 – 12:00	Group leaders	Teamwork
13:00 – 15:30	FAIRNESS Mini-Conference	

Teamwork group leaders

1.) Origin of radon in the Buda thermal Karst

Group leaders: Dr. Anita Erős, Katalin Hegedűs-Csondor, s, Dr. Ákos Horváth, ELTE Eötvös Loránd University, Institute of Geography and Earth Sciences

Project room: *1th floor 1.701* in the another university building 1/D in the Department of Geology

2.) Meteorological and air quality measurements in urban environment green zones

Group leaders: Dr. Rita Pongrácz and Dr. Róbert Mészáros, Department of Meteorology, Institute of Geography and Earth Sciences, ELTE Eötvös Loránd University

Project room: *6th floor 6.113*, Department of Meteorology, in the same building as the lectures

3.) Radon measurements, infra-camera, with standard meteorological data

Group leaders: Dr. Ákos Horváth, Zsófia Nógrádi, Institute of Physics, Dr. Tamás Weidinger, Department of Meteorology, Institute of Geography and Earth Sciences, ELTE Eötvös Loránd University, Budapest

Project room: *Basement P 22*, Institute of Physics and Astronomy, in the same building as the lectures

4.) Utilization of meteorological data in urban air quality and aerosol research

Group leaders: Prof. Imre Salma, Institute of Chemistry, Dr. Tamás Weidinger, Department of Meteorology, Institute of Geography and Earth Sciences, ELTE Eötvös Loránd University BPArt (<http://salma.web.elte.hu/BpArt/index.html>)

Project room: *3th floor 3.48*, Institute of Chemistry, in the same building as the lectures

5.) The relationship between solar power generation, and various meteorological parameters and cloud cover

Group leaders: Dr. Veronika Oláhné Groma, Lilla Barancsik, Hun-Ren, Energy Strategy and Environmental Effects (E-SEE), <https://www.ek.hun-ren.hu/en/energy-strategy-and-environmental-effects-e-see-research-group/>

Project room: *6th floor 6.129*, Department of Meteorology, in the same building as the lectures

6.) Energy hill concept (Complex energy utilisation of landfill gas with solar panels and wind turbines)

Group leaders: Dr. Emőke Imre, Péter Felker, Prof. Ákos Nemcsics, Dr. Antal Ürmös, Óbuda University, Budapest

Project room: *6th floor 6.133*, Department of Meteorology, in the same building as the lectures

7.) Meteorological sensor calibration laboratory in HungaroMet Main Observatory

Group leader: Roland Steib, HungaroMet, Budapest

Project room: *5th floor 5.86*, in the same building as the lectures

1. Origin of radon in the Buda thermal Karst

Group leaders: Dr. Anita Erőss, Katalin Hegedűs-Csondor, Dr. Ákos Horváth,
ELTE Eötvös Loránd University

Project aims: The participants will study the radon concentration in the caves of Buda Thermal Karst together with additional measurements – various origins of radon can be revealed.

Measured parameters:

Radon, CO₂ content, air temperature and humidity.

Radon, temperature, specific electrical conductivity of the cave filling water.

Radium in the water (?)

Measuring devices, instruments:

Radon in the air: Alpha Guard.

CO₂ in the air: Analox Aspida CO₂.

Radon in the water: liquid scintillation counting, Tricarb-1000.

Water temperature, specific electric conductivity: YSI ProPlus.

Radium in water: alpha spectrometry applied on Nucfilm discs.

Study sites

Rudas Spa, Török Spring (Gellért Hill area)

Szemlő-hegy Cave, eventually Molnár János Cave (Rózsadomb area)

Required time for the field measurements: 2-3 hours per site (!)

2. Meteorological and air quality measurements in urban environment green zones

Group leaders: Dr. Rita Pongrácz and Dr. Róbert Mészáros, Department of Meteorology, Institute of Geography and Earth Sciences, ELTE Eötvös Loránd University

Aims:

- Conducting point measurements. Learning about and conducting mobile air quality measurements (on foot and by bicycle).
- Performing measurements with high spatial and temporal resolution.
- Assessment of spatial and temporal variations of atmospheric variables for different surfaces and built-up areas.
- Monitoring air quality in urban environment. Identifying Pollution Hotspots. Assessing traffic impacts.
- Public awareness and education.

Instruments:

We plan to use the following instruments for the fixed and mobile measurements:

- Testo 635-2 hand-held humidity/temperature gauge.
- Infrared thermometers for measuring different urban surface temperatures.
- DustTrak II Aerosol Monitors (8532) for measuring PM_{2,5}, PM₁₀ concentrations.
- Optionally: other low-cost air quality sensor (e.g. AirVisual Pro, AtmoTube) for measuring the concentrations of aerosol particles (PM_{2,5}, PM₁₀), CO₂, VOC and atmospheric variables (temperature, relative humidity, atmospheric pressure).
- Determination of GPS coordinates (e.g. with mobile application).

● **Implementation of the project:**

- Planning the measurements.
- Carrying out the measurements around the ELTE campus.
- Fixed meteorological and air quality measurements.
- Mobile measurements on foot and by bicycle.
- Duration of measurements 2-3 hours/day (due to the capacity of instruments).
- Temporal resolution of measurements: 1-10 minutes.
- Database construction from measured data.
- Error detection.
- Data organisation, plotting of time series, spatial distributions, derivation of statistical values
- Possible comparison with reference measurements (odp.met.hu, <https://legszennyezettseg.met.hu/levegominoseg>).

3. Radon measurements, infra-camera, with standard meteorological data

Group leaders: Dr. Ákos Horváth and Dr. Zsófia Nógrádi,

Institute of Physics, ELTE Eötvös Loránd University

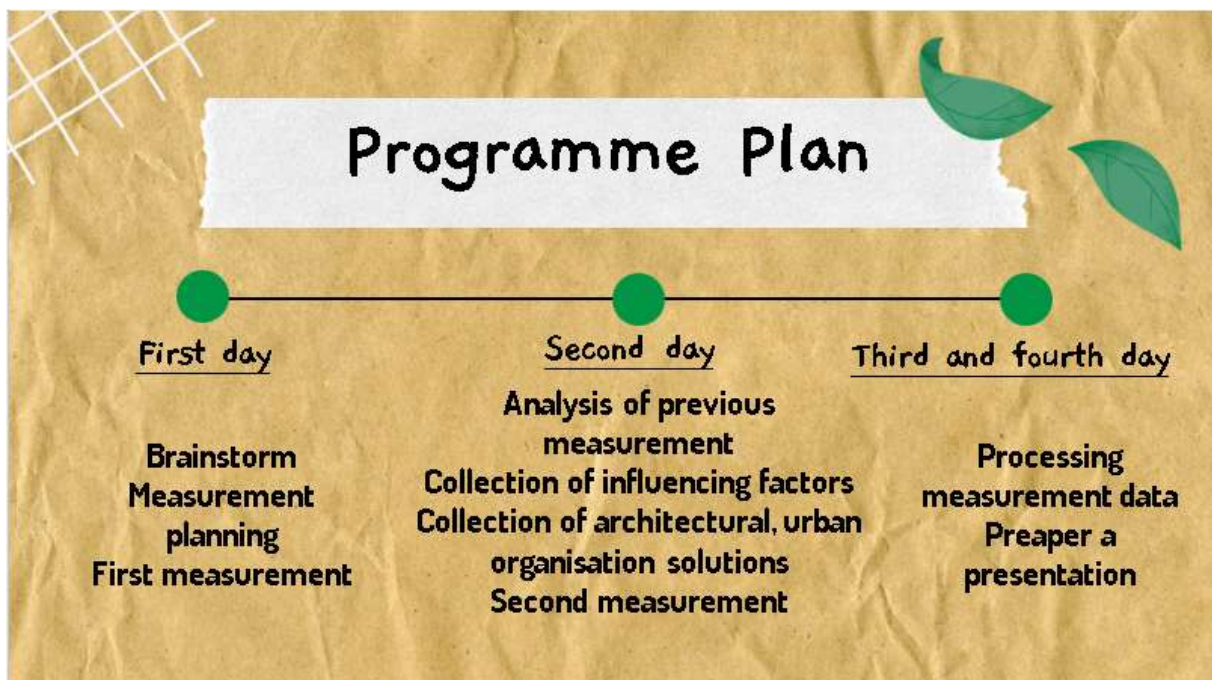
Dr. Tamás Weidinger, Department of Meteorology, Institute of Geography and Earth Sciences, ELTE Eötvös Loránd University, Budapest

Objectives:

- Daily variation of radon concentration and connection with PBL height and local meteorological elements.
- Surface temperature measurements above different types of vegetation and urban surfaces. Investigation of local differences and local microclimate.

Instrumentation: RAD7 radon sensor, infra-camera, mobile weather station, handheld instrument for wind, temperature and relative humidity

Additional dataset: 10 minutes time resolution urban meteorological measurements from HungaroMet.



4. Utilization of meteorological data in urban air quality and aerosol research

Group leaders: Prof. Imre Salma, Institute of Chemistry, Dr. Tamás Weidinger, Department of Meteorology, Institute of Geography and Earth Sciences, ELTE Eötvös Loránd University BPArt (<http://salma.web.elte.hu/BpArt/index.html>)

Objectives:

Urban air quality and source apportionment, chemical and physical properties and quantities expressing the dynamic character of the air, measurement and interpretation of the aerosol particle number concentrations and size distributions, influence of local meteorology on measured and modelled properties, dispersion correction

Main instruments:

- Condensation particle counter.
- Differential particle mobility sizer.
- Meteorological (air T, RH, WS, WD, Grad) sensors.

Data retrieval:

- BPArt measurements and database.
- Copernicus Climate Change Service.
- ERA5 Family datasets.
- ECMWF reanalysis (planetary boundary layer mixing height).

Schedule of the project work:

- Formulation of a challenge.
- Review the state-of-the-art of the challenge through systematic literature search.
- Perform measurements using the appropriate analytical method to address the proposed challenge.
- Data evaluation and interpretation.
- Preparation of the presentation.

5. The relationship between solar power generation, and various meteorological parameters and cloud cover

Group leaders:

Dr. Veronika Oláhné Groma, **Lilla Barancsuk**, Hun-Ren, Energy Strategy and Environmental Effects (E-SEE), <https://www.ek.hun-ren.hu/en/energy-strategy-and-environmental-effects-e-see-research-group/>

Short description: The research station located in the KFKI campus is a complex measuring station, which includes instruments for measuring temperature, humidity, atmospheric pressure, wind speed, global radiation, and diffuse radiation, as well as a full sky camera that takes pictures of the sky. Additionally, it has various types of solar panels, for which production data are also available.

Based on a 1-year dataset with 1-minute resolution, participants will examine the factors influencing solar power production through correlation analysis and comparison with images taken by the all-sky camera. The sky images enable also the discussion of the light transmission characteristics of different cloud types. The station and instruments are shown at the site.

Planned In situ measurement tasks include i) comparing the station's radiometer with a calibrated instrument, ii) measuring the temperature of the solar panels, and iii) analyzing the effect of cloud cover based on high-resolution (10 s) radiation measurements.

6. Energy hill concept (Complex energy utilisation of landfill gas with solar panels and wind turbines)

Group leaders: Dr. Emőke Imre, Péter Felker, Prof. Ákos Nemcsics, Dr. Antal Ürmös from Óbuda University, Budapest

Topic A / B

A: Aims:

To analyse the hill effect of a future solar energy plant (on a 55 m high MSW landfill hill), for this aim, (i) solar radiation measurements in various slopes, (ii) wind velocity measurements on the hill surface (around solar panels) and on the hilltop + 2 m.

B: Aims:

To analyse the hill effect of a future wind energy plant (on a 55 m high MSW landfill hill), for this aim, wind velocity measurements on the hilltop + 2 m and + 18 m.

Instrumentation:

- Pyranometers (Kipp & Zonen) and Vaisala wind sensor with Campbell datalogger.
- Low-cost meteorological station.
- Permanent meteorological station.
- Handheld instruments for wind and temperature measurements (AN-10, Voltcraft).

Additional meteorological information:

- Generally available data: Official, nearby weather station data; Boreas data.
- Site data.
- Site plan with measuring points.
- Data prepared for the students.

Theory:

- Statistical testing, statistical distributions.
- Simple laws to extrapolate the variation of wind velocity with height.
- Bird software for comparison of measured and estimated solar radiation.

7. Meteorological sensor calibration laboratory in HungaroMet Main Observatory

Group leader: Roland Steib, HungaroMet, Budapest

Objectives:

- Understanding the measuring instruments and quality assurance procedures used by the HungaroMet (Location Main Observatory in Pestszentlőrinc).
- Participation in the calibration process of wind speeds, temperature moisture and precipitation sensors.
- Constructing and evaluating calibrating curves.

Available instrumentation:

- Calibration laboratory (large wind tunnel, dew point hygrometer, thermostat, etc.)
- Instrumentation of Main Meteorological Observatory of HungaroMet.



Meteorological garden

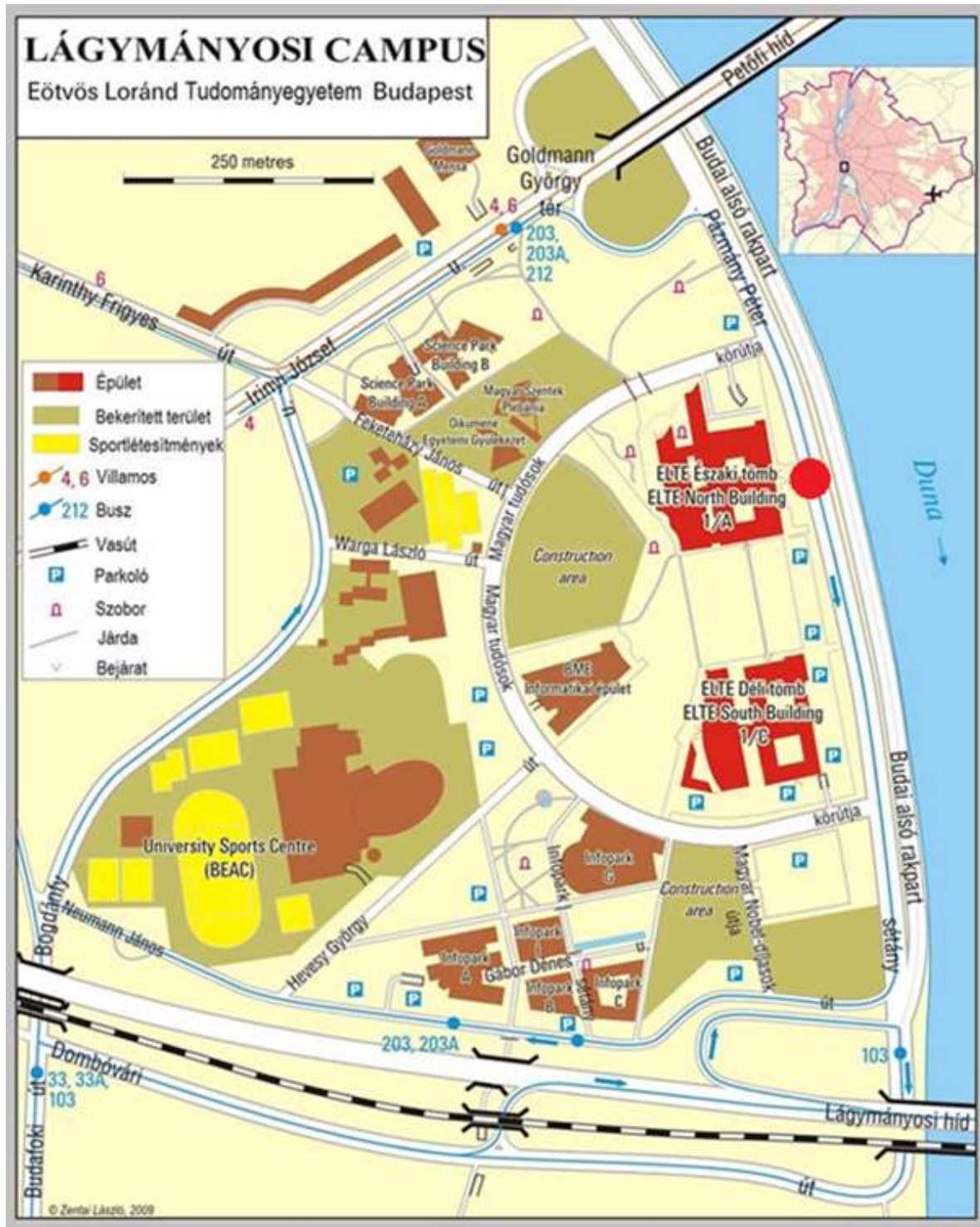


Wind tunnel 8421, Theodor Friedrichs & Co.



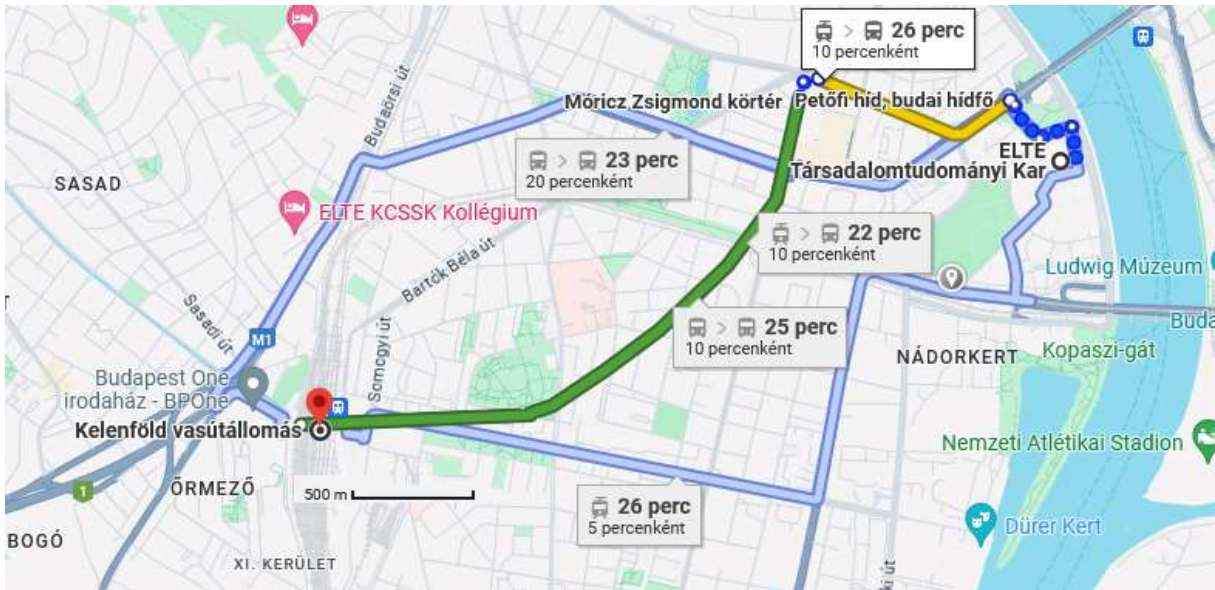
Rain gauge calibration unit

Maps, additional information

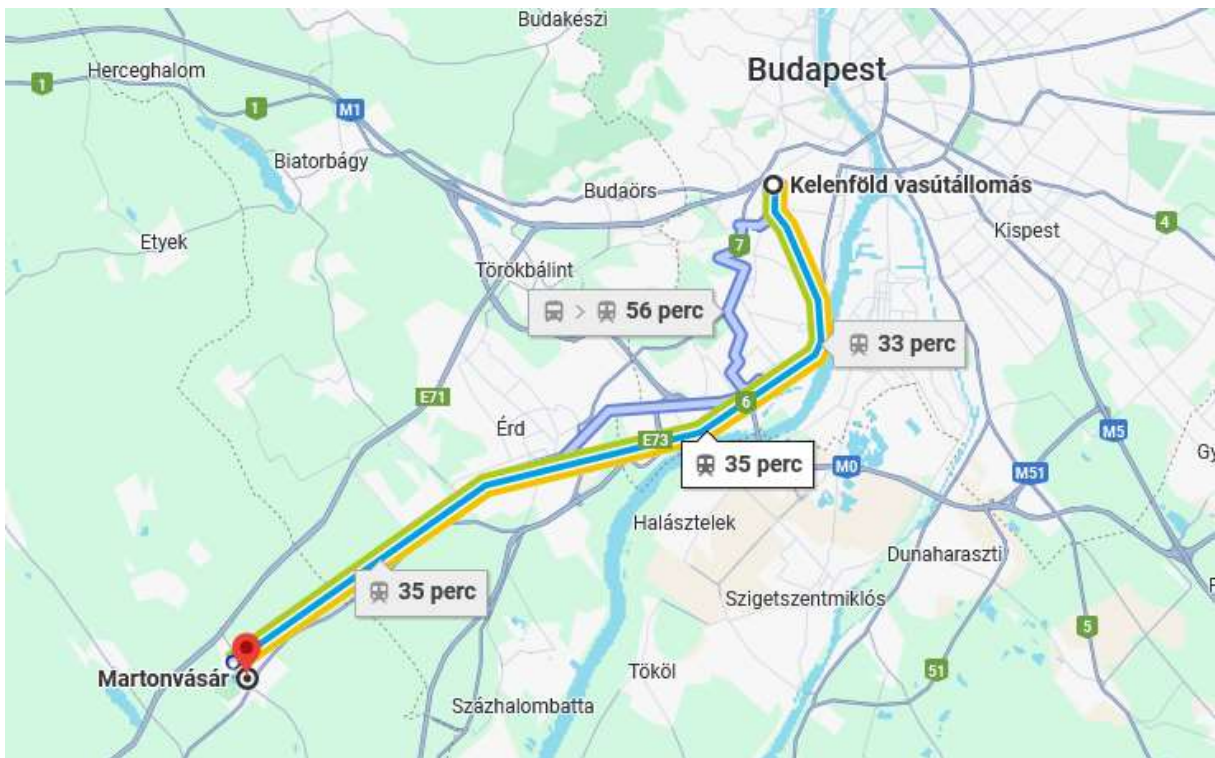


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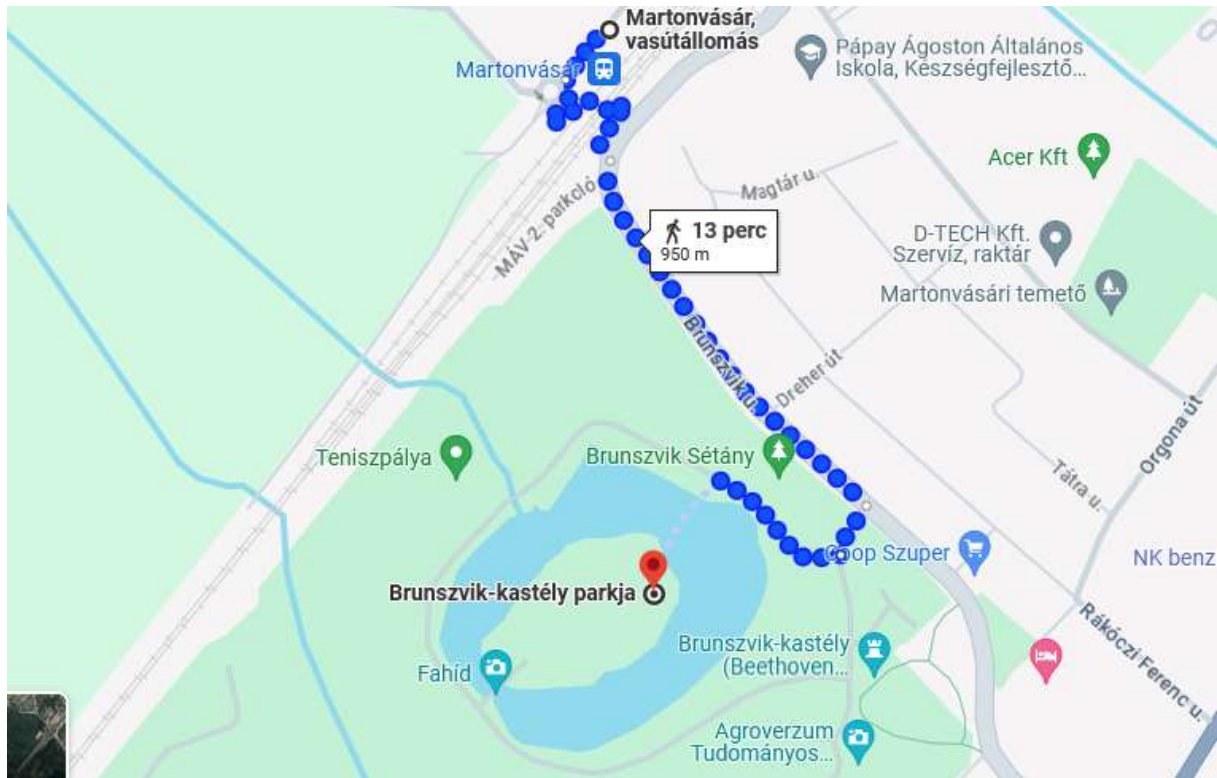
Maps: Budapest – Martonvásár - Budapest



University – Kelenföld railway station

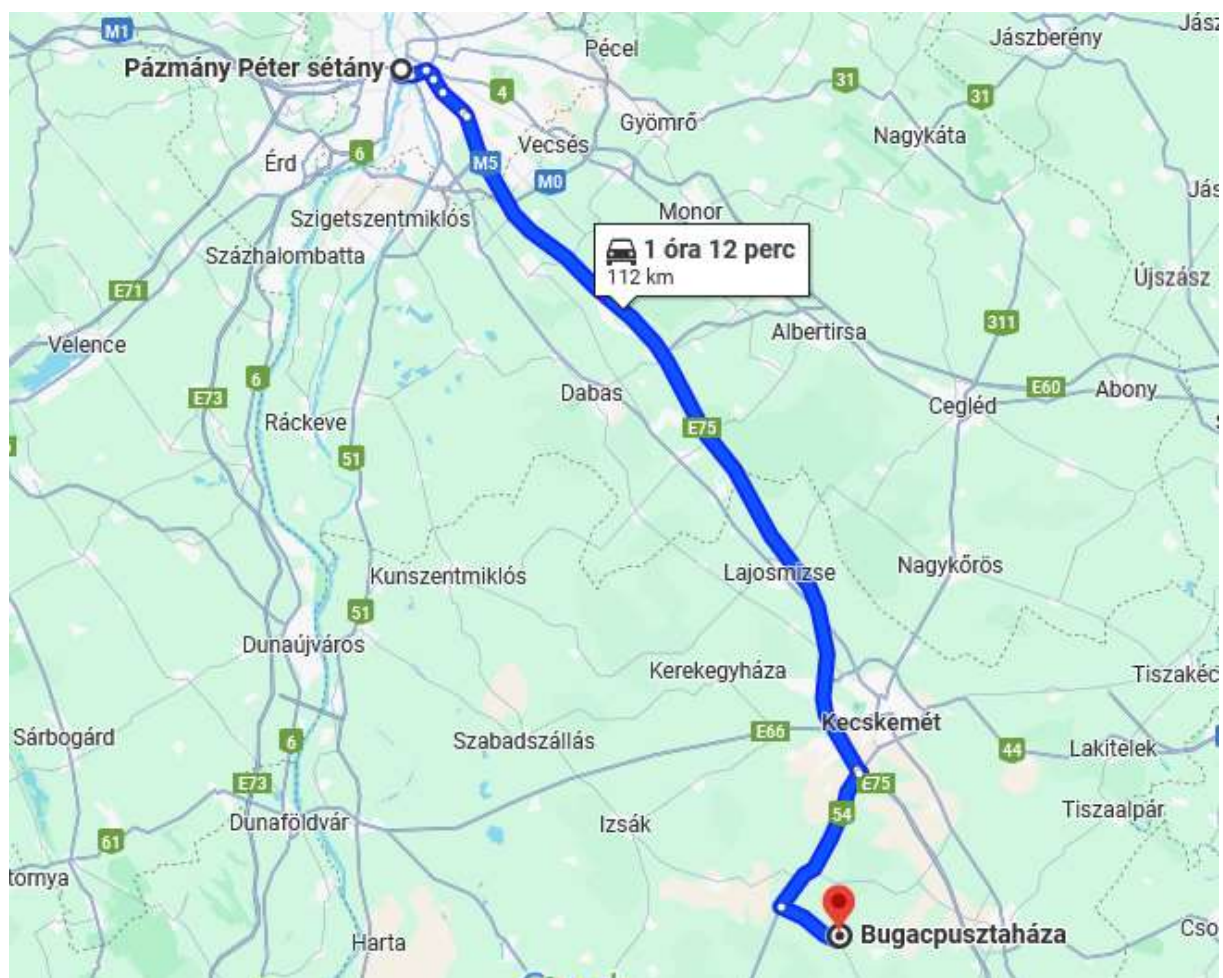


Kelenföld – Martonvásár

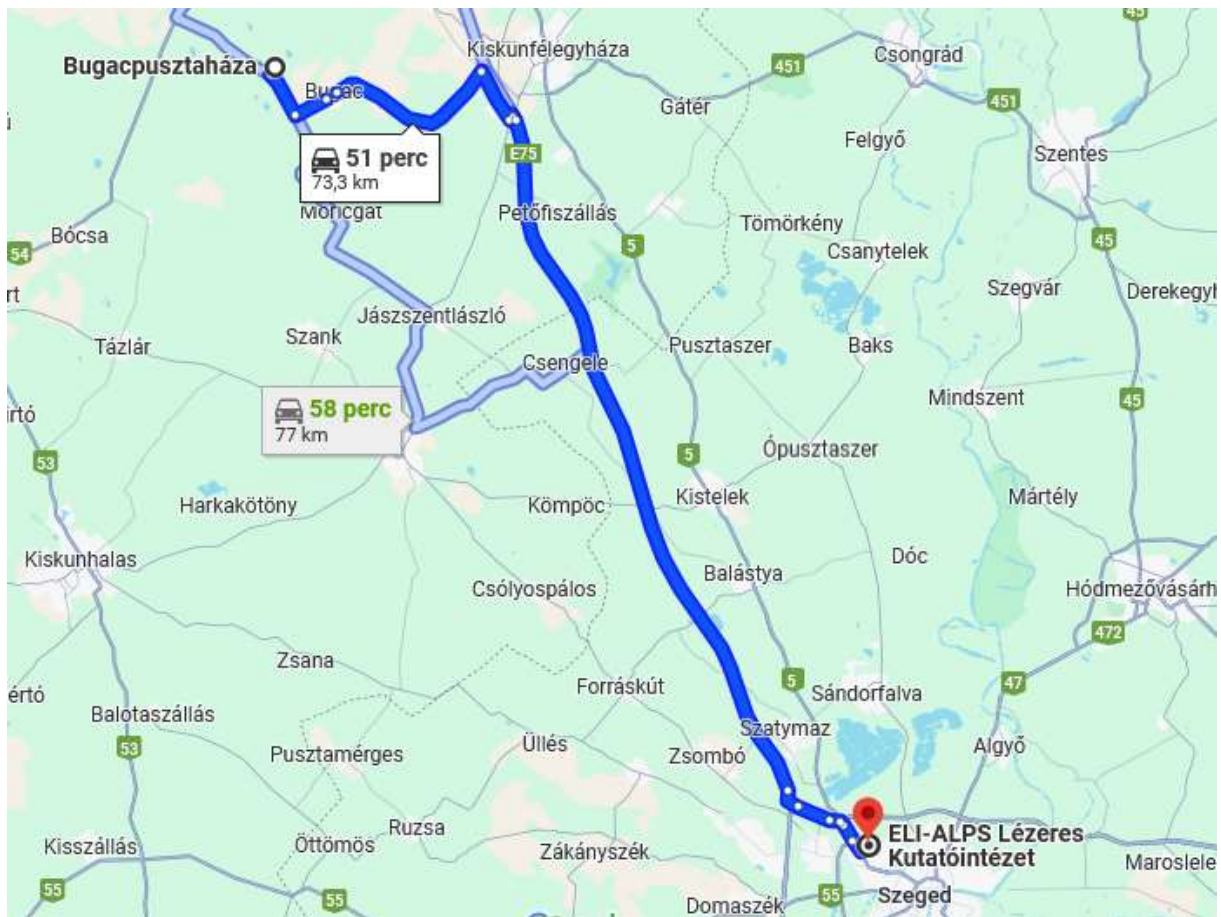


Martonvásár railway station - HUN-REN Centre for Agricultural Research, Martonvásár

Maps: Budapest – Szeged – Budapest study tour



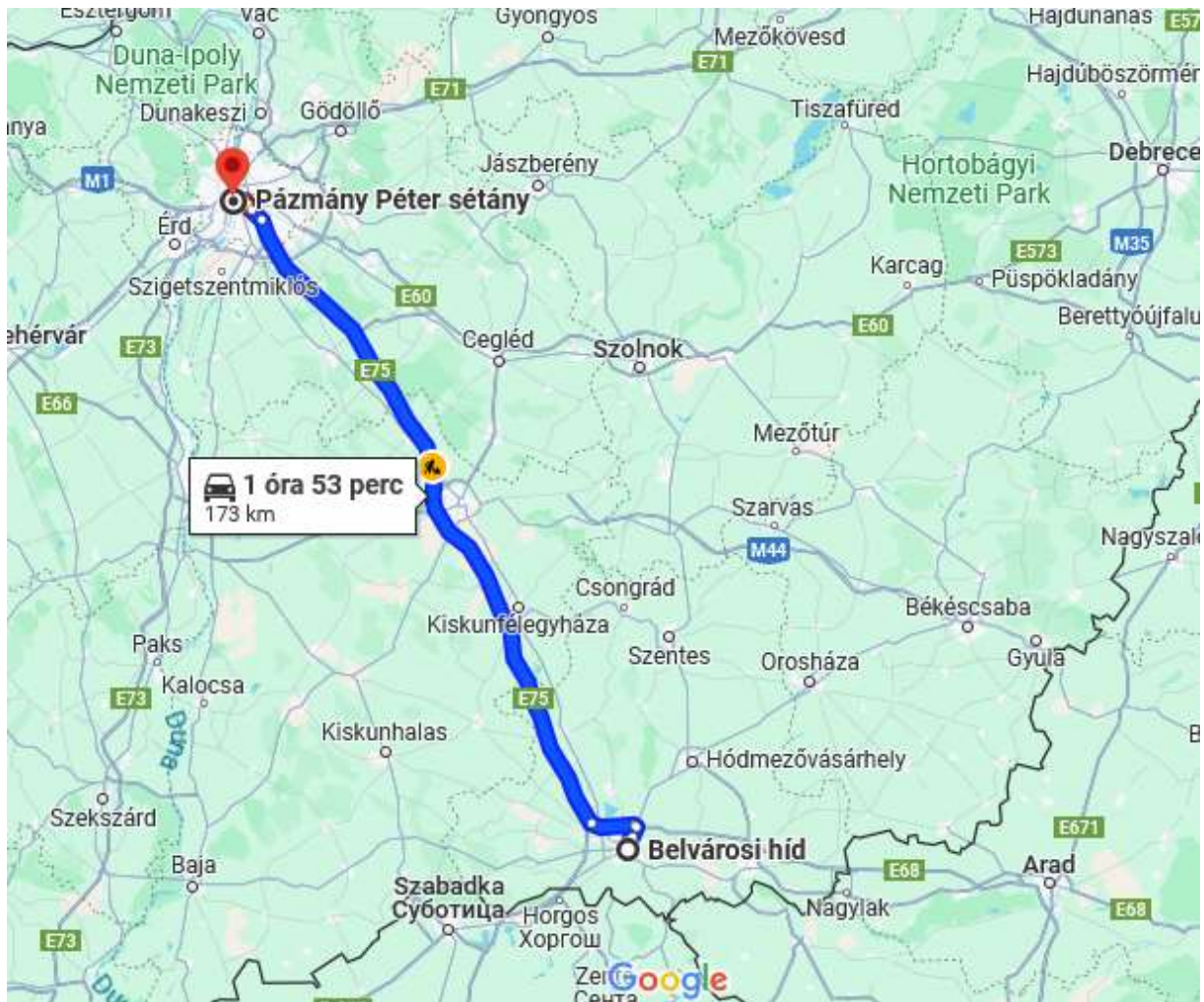
Budapest University – Bugacpusztaháza



Bugacpusztaháza – ELI (extreme Light Infrastructure) <https://www.eli-alps.hu/hu>



ELI – Szeged down town



Szeged - Budapest