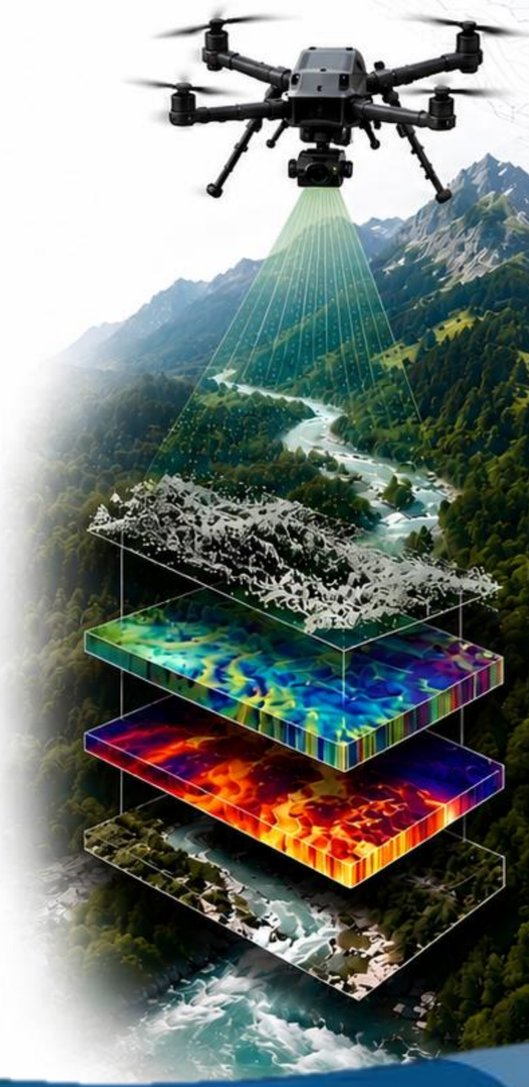
IRSS 2026

INTERNATIONAL REMOTE SENSING SUMMER SCHOOL

Mountain river systems dynamics from a multisensor and multiscale perspective

Stará Lesná, Tatry Mountains, Slovakia
19. 7. 2026 - 24. 7. 2026

SEE MORE.
UNDERSTAND BETTER.
MANAGE SMARTER.



- **UAV** — AERIAL IMAGING
- **LiDAR** — 3D POINT CLOUDS
- **HYPERSPECTRAL** — SPECTRAL INFORMATION
- **THERMAL** — TEMPERATURE MAPPING
- **MULTISCALE** — CROSS-SCALE ANALYSIS
- **SATELLITE** — EARTH OBSERVATION

PAVOL JOZEF ŠAFÁRIK UNIVERSITY IN KOŠICE

Università degli Studi di Cagliari

ISTITUTO NAZIONALE DI GEOFISICA E VULCANOLOGIA

INSTITUTE OF GEOGRAPHY SLOVAK ACADEMY OF SCIENCES

CHARLES UNIVERSITY

PHOTOMEP

Erasmus+

FROM SARDINIA TO THE HIGH TATRAS

The story behind IRSSS 2026

IRSSS 2026

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FROM SARDINIA TO THE HIGH TATRAS

IRSSS 2026

The story behind IRSSS 2026

Sal 'e Porcus,
Sardinia, Italy

UPJŠ team at IRSSS 2024, San Vero Milis - UAV data collection with hyperspectral camera and LiDAR

It all began in July 2023...

At Sal'e Porcus, Sardinia (Italy), we joined the first International Remote Sensing **Summer School** organized by **UNICA, INGV, ASI** and **AIT** in collaboration with **NASA** and **UPJŠ** in Košice.

During an intensive week of fieldwork, we performed **UAV** surveys with **hyperspectral** and **LiDAR** sensors, ground measurements and **satellite data** acquisition for calibration and validation activities.

This experience demonstrated the power of combining hands-on fieldwork with advanced Earth Observation technologies and **inspired the idea** to extend this collaborative concept to mountain river systems.

IRSSS 2026 continues this story – from the Mediterranean coast to the High Tatras, bringing together young researchers and experts from around the world.

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2023

Sal'e Porcus, Sardinia, Italy

The beginning of our collaboration

2024

IRSSS 2024

Strengthening partnerships and sharing knowledge

2026

Stará Lesná, High Tatras, Slovakia

IRSSS – continuing the journey in mountain river systems

IRSS 2026

INTERNATIONAL REMOTE SENSING SUMMER SCHOOL

Mountain river systems dynamics from a multisensor and multiscale perspective

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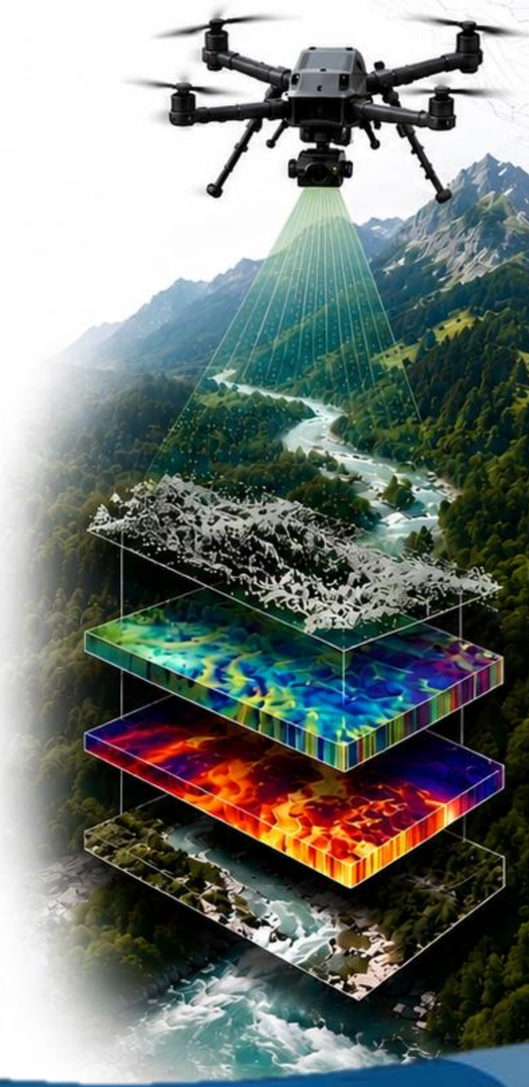

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PHOTOMEP

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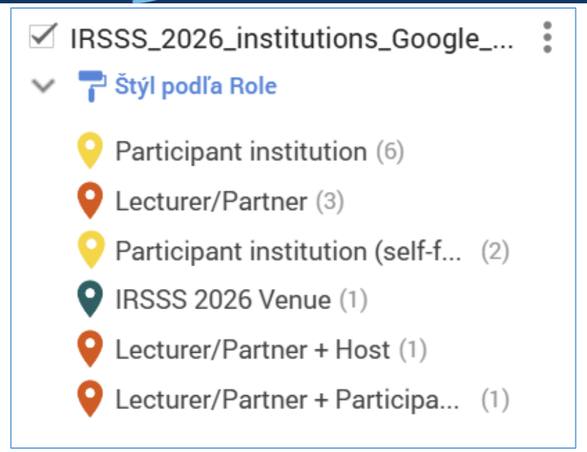
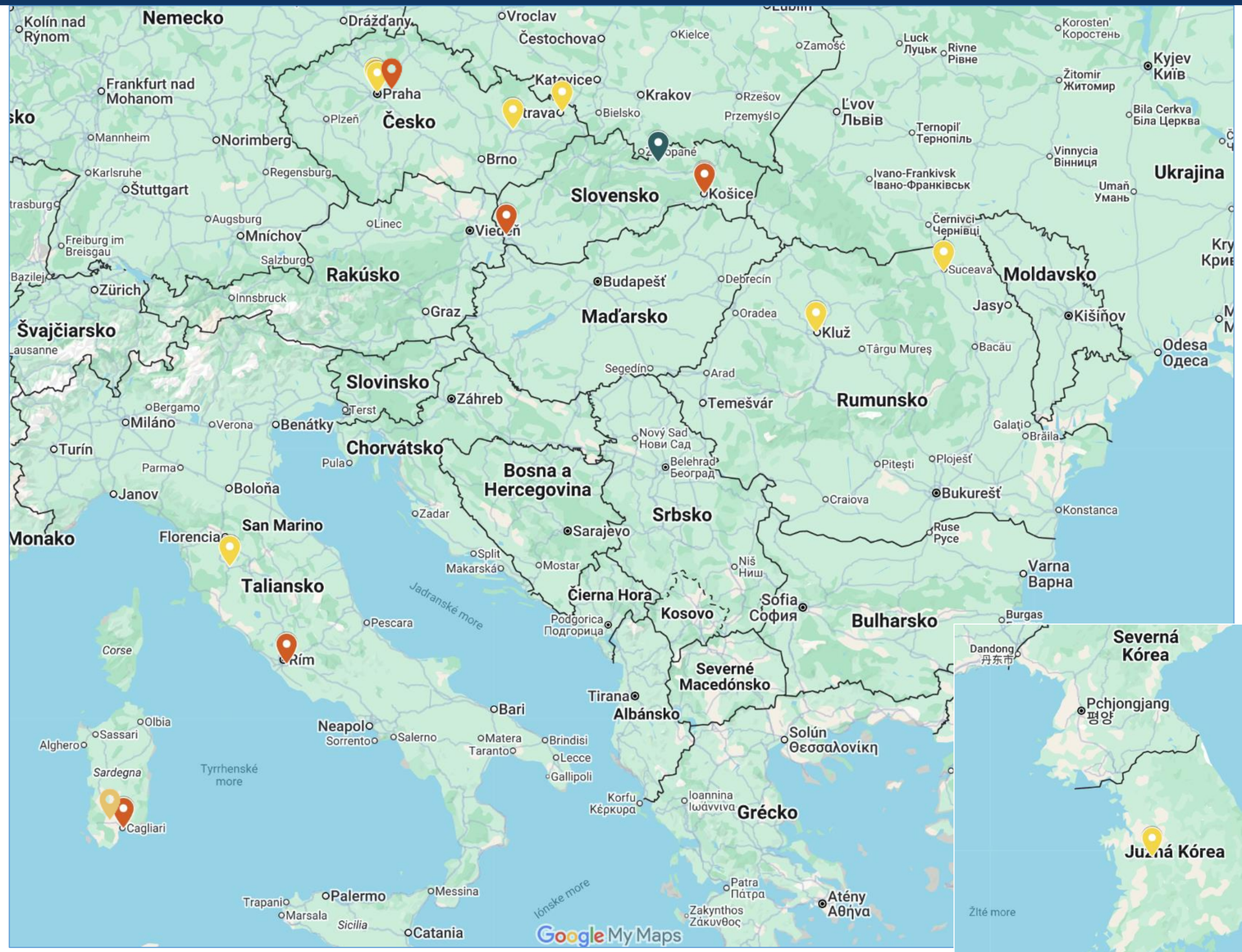
IRSSS 2026: a truly international group



- Pavol Jozef Šafárik University in Košice, Slovakia
- Slovak Academy of Sciences, Bratislava, Slovakia
- Photomap, Košice, Slovakia
- Istituto Nazionale di Geofisica e Vulcanologia / INGV, Rome, Italy
- University of Cagliari, Italy
- Charles University, Prague, Czechia
- University of Siena, Italy
- Palacký University Olomouc, Czechia
- Czech University of Life Sciences Prague ,Czechia
- University of Ostrava, Czechia
- Babeș-Bolyai University, Cluj-Napoca, Romania
- Ștefan cel Mare University of Suceava, Romania
- Korea Environment Institute, Sejong, South Korea



[MAP online]

IRSSS 2026: The central idea

MOUNTAIN LANDSCAPE / RIVER SYSTEM = DYNAMIC ENVIRONMENT

SATELLITE
Earth observation · Copernicus
↓
AIRBORNE
LiDAR, RGB
↓
UAV
RGB · lidar · multispectral · hyperspectral · thermal
↓
TERRESTRIAL
TLS · close-range sensing
↓
FIELD
GNSS · Spectrometry · validation

MULTISENSOR × MULTISCALE × MULTIDISCIPLINARY

IRSSS 2026: The central idea

MOUNTAIN LANDSCAPE / RIVER SYSTEM = DYNAMIC ENVIRONMENT

Wind storm Novemebr 2004, (gusts over 230 km/h), wind 120 km/h (damaged 11x11 km, 16 800 football pitches)

SITA/HZS https://www.topky.sk/cl/10/1724963/MIMORIADNA-SITUACIA-Pohroma-na-severe-Slovenska--VIDEO-Zaplavene-Tatry--evakuacia-ludi

IRSSS 2026: The central idea

MOUNTAIN LANDSCAPE / RIVER SYSTEM = DYNAMIC ENVIRONMENT

Wind storm, 19 Novemeber 2004, (gusts over 230 km/h), wind 120 km/h

SITA/HZS https://www.topky.sk/cl/10/1724963/MIMORIADNA-SITUACIA-Pohroma-na-severe-Slovenska--VIDEO-Zaplavene-Tatry--evakuacia-ludi

IRSSS 2026: The central idea

MOUNTAIN LANDSCAPE / RIVER SYSTEM = DYNAMIC ENVIRONMENT

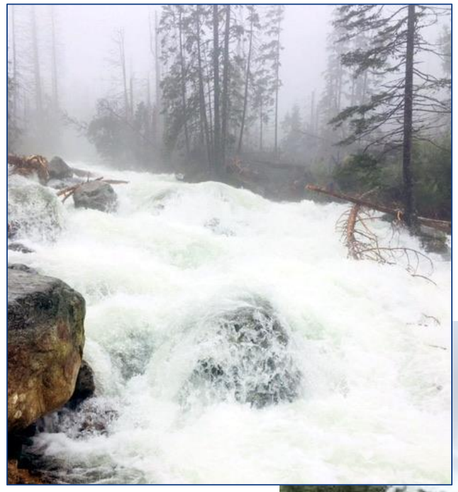
Subsequent forest fires in August 2025

https://www1.pluska.sk/regiony/peklo-vo-vysokych-tatrach-od-najvacsieho-poziaru-uplynulo-uz-20-rokov-ako-to-vtedy-vyzeralo/2

IRSSS 2026: The central idea

MOUNTAIN LANDSCAPE / RIVER SYSTEM = DYNAMIC ENVIRONMENT

Stará Lesná - flash floods XX.XX. 2018 – over 100 mm/h of rainfall intensity



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IRSSS 2026: From sensors to understanding

A continuous IRSSS workflow: learn → acquire → process → integrate → interpret

TOOLS
satellite • UAV • LiDAR • hyperspectral • field

WORKFLOW
learn • observe • acquire • process • analyse • integrate

ENVIRONMENTAL INSIGHT
morphology • vegetation • dynamics • processes

BY FRIDAY
strengths & limits • collaboration • research questions

A drone is not the objective.
A point cloud is not the objective.
A satellite image is not the objective.

They are tools for extracting meaningful environmental information.

YOUR ROLE

Ask • Explore • Collaborate • Share

Do not only sit with people you already know — use the week to connect methods, people and questions.

FRIDAY OUTCOME — understand sensor roles + limitations | combine datasets | connect remote-sensing products with real environmental questions

PAVOL JOZEF ŠAFÁRIK UNIVERSITY
IN KOŠICE

WHO WE ARE

Faculty of Science
Pavol Jozef Šafárik University in Košice
Tradition since 1963

Institute of Geography
16 academic staff
3 departments • 4 laboratories

Research & Education
Interdisciplinary research
Modern infrastructure and technologies

International Collaboration
Global partnerships
Joint projects and summer schools

220 000
people in Košice

20 000
university students

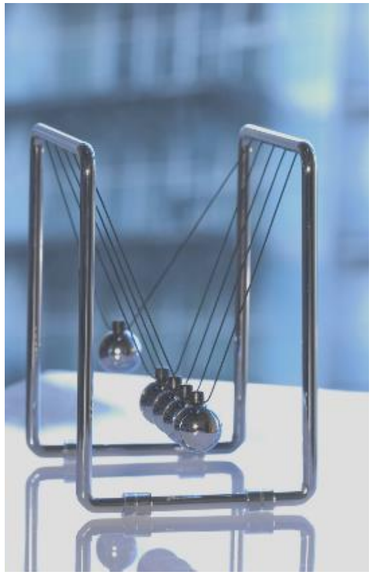
3
universities

IT Valley
innovation & opportunities

a City on the Move

PAVOL JOZEF ŠAFÁRIK UNIVERSITY IN KOŠICE

FACULTY OF SCIENCE – Research & Education units



INSTITUTE OF PHYSICS

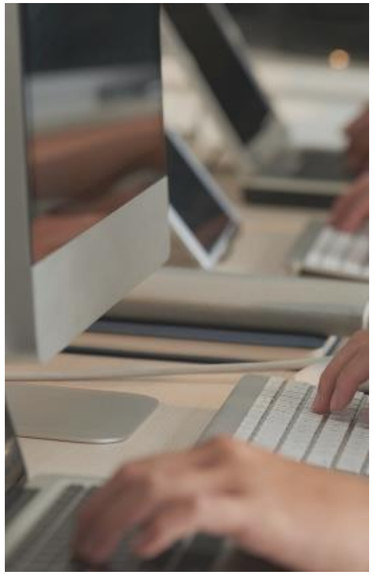
55 acad.staff

INSTITUTE OF CHEMISTRY

46 acad.staff

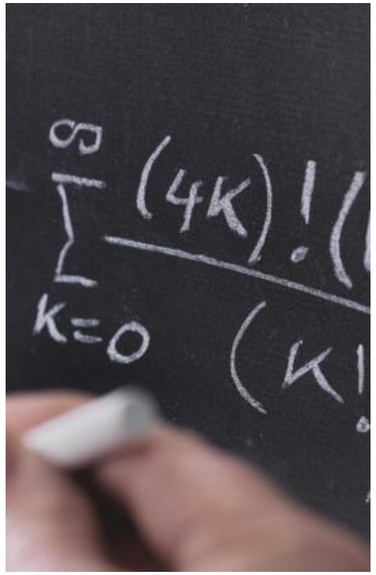
INSTITUTE OF BIOLOGY AND ECOLOGY

52 acad.staff



INSTITUTE OF INFORMATICS

21 acad.staff



INSTITUTE OF MATHEMATICS

26 acad.staff

INSTITUTE OF GEOGRAPHY

16 acad.staff

PAVOL JOZEF ŠAFÁRIK UNIVERSITY IN KOŠICE

INSTITUTE OF GEOGRAPHY

48.728725° N, 21.248469°E

- **16 academic staff** (1 prof., 5 assoc.prof., 6 res. assist., 2 researchers) + 1 admin. support staff
- **3 departments**
  - Department of Geoinformatics
  - Department of Physical Geography
  - Department of Human Geography
- **4 laboratories**

PAVOL JOZEF ŠAFÁRIK UNIVERSITY IN KOŠICE

INSTITUTE OF GEOGRAPHY – EDUCATION PROFILE

Single degree study

- BSc. Geography and Geoinformatics
- MSc. Geography and Geoinformatics
- PhD. Geoinformatics and Remote Sensing

Joint degree study

- BSc., Geography with other Science (e.g. Mathematics, Computer Science, Physics, Biology, Chemistry, Slovak, German, English language, History)
- Msc. Geography teaching

- https://studijne-programy.upjs.sk/en/faculty/PF

Copernicus Academy

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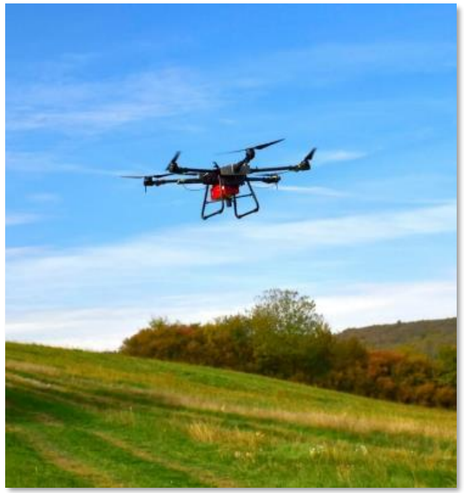
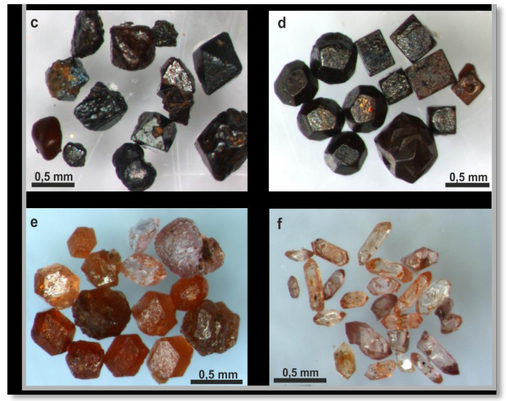
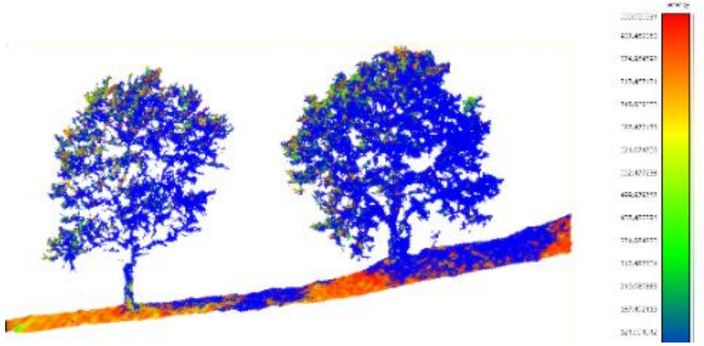
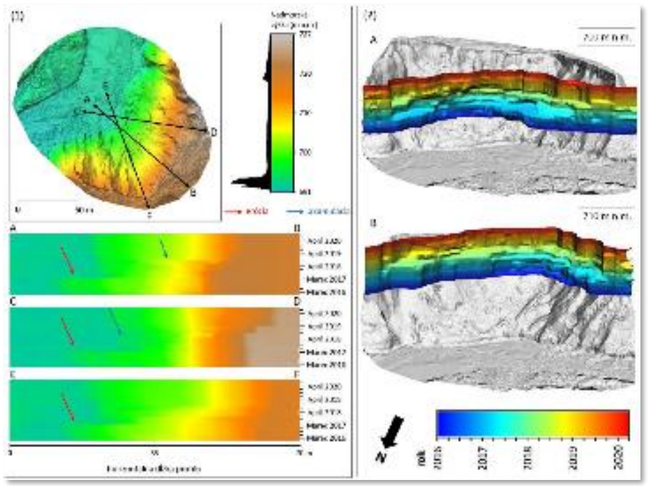
INSTITUTE OF GEOGRAPHY – RESEARCH PILLARS

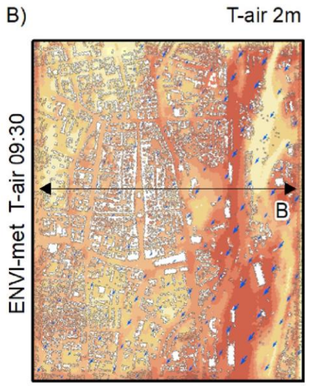


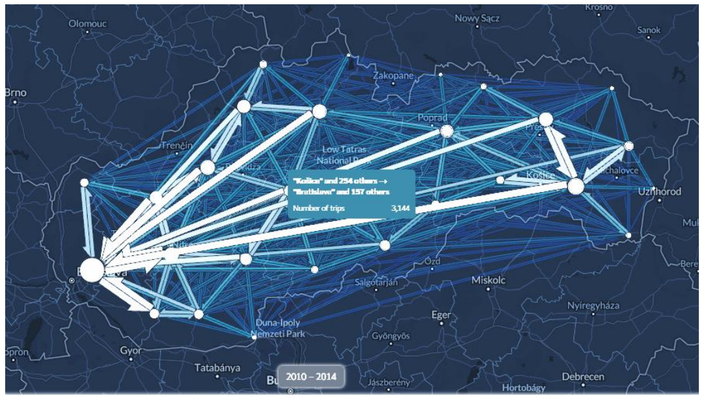
- Earth-Surface Modelling & Geomorphometry
- Urban Climate & Environmental modelling
- Karst & Speleology
- Sedimentology & Palaeogeography
- Demographic migration & change
- Sustainable energy & its environmental impact
- Geography education





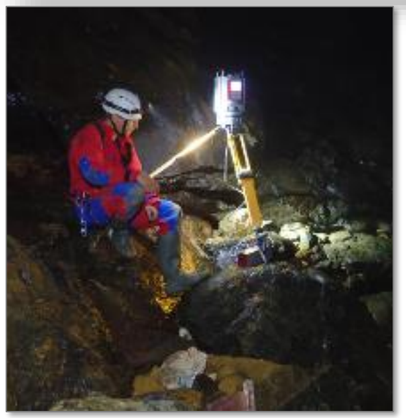






Advanced Geospatial Infrastructure

- **UAVs platforms:** DJI AGRAS T30, DJI PHANTOM 4 Pro, DJI Matrice 210, MAVIC 2 thermal, multispectral
- **UAV sensors: lidar** Riegl VUX-1, **hyperspec.** Specim AISA KESTREL 10, FLIR **Thermal** camera, **multispec. DJI MAVIC MS,**
- **Terrestrial lidar:** Riegl VZ-1000 with NIKON D-700; Faro FOCUS 3D
- **GNSS + Electronic tacheometry:** TOPCON
- **Software**: RiAcquire, RiScanPro, CaliGEO Pro, Agisoft Metashape, LAStools, ENVI, ArcGISPro, GRASS GIS

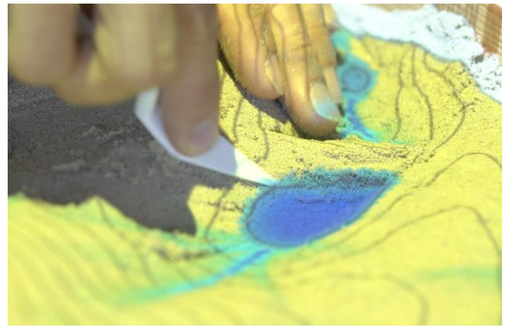


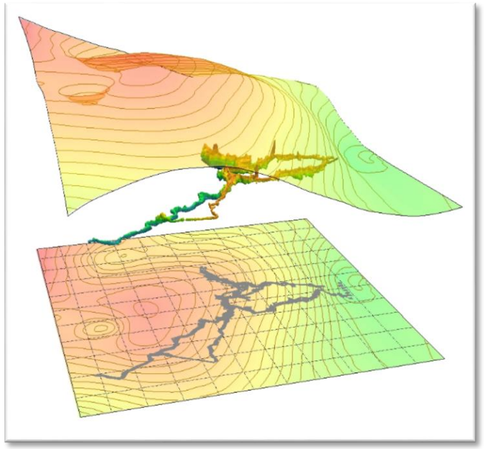
ENVI

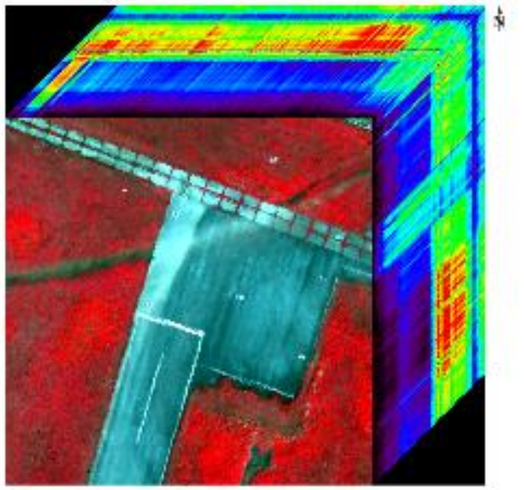
Google Earth Engine

ArcGIS

grass gis
Bringing advanced geospatial technologies to the world

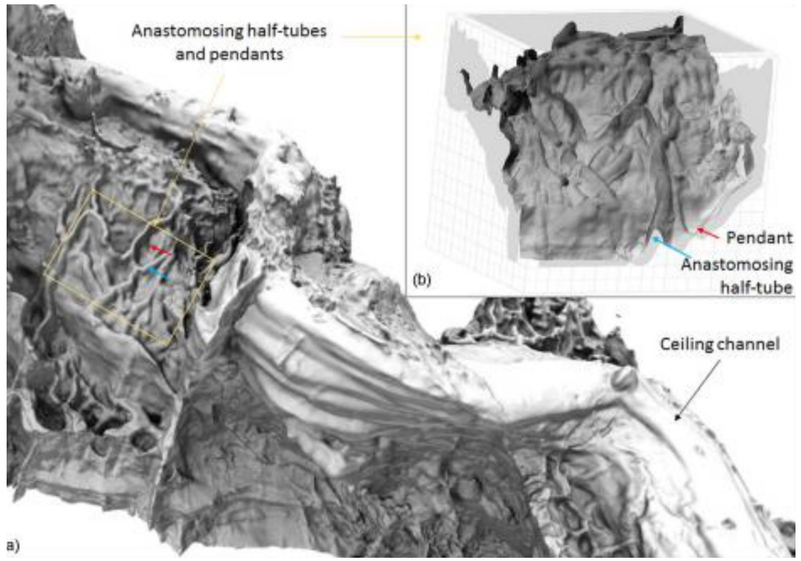


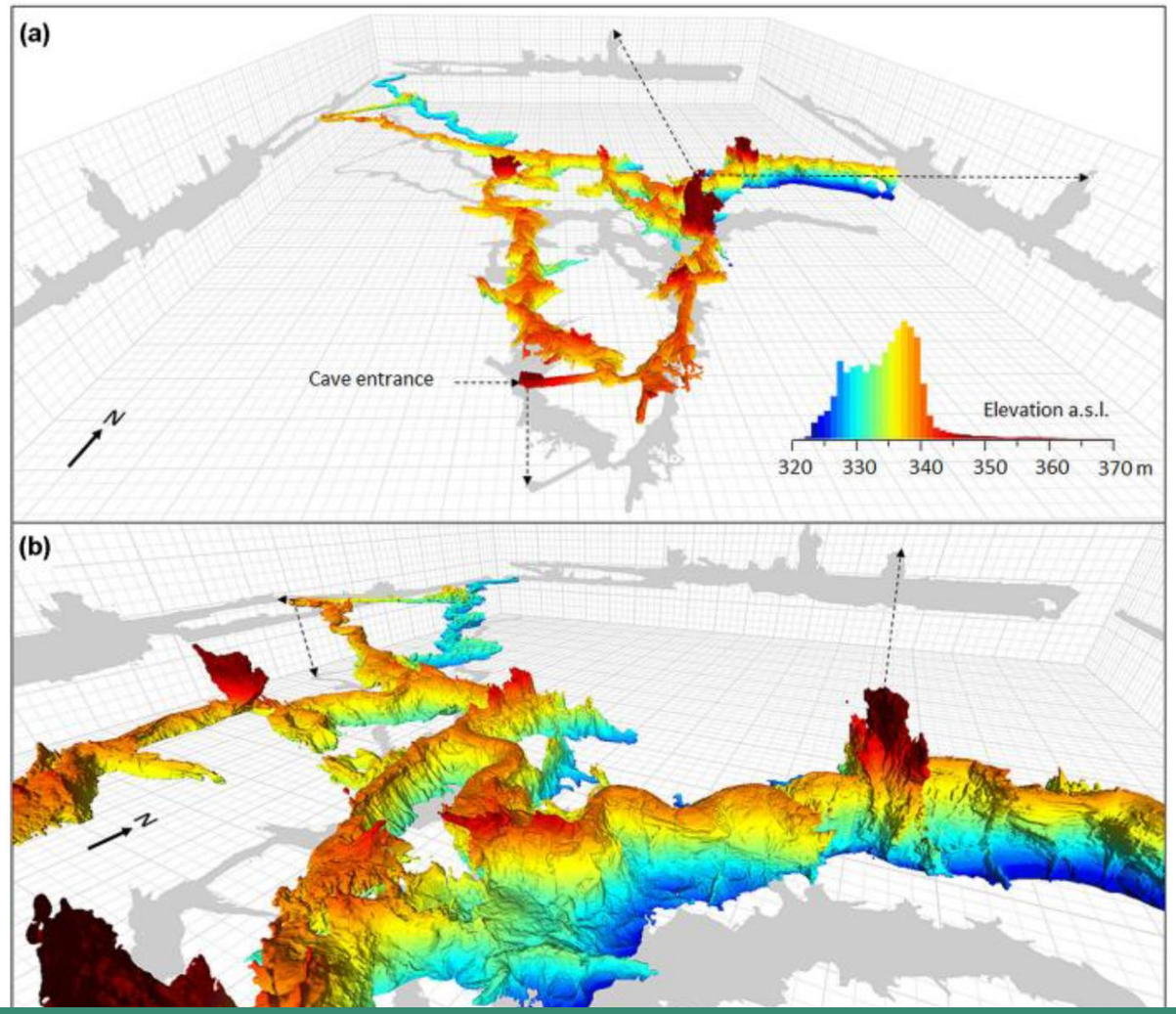


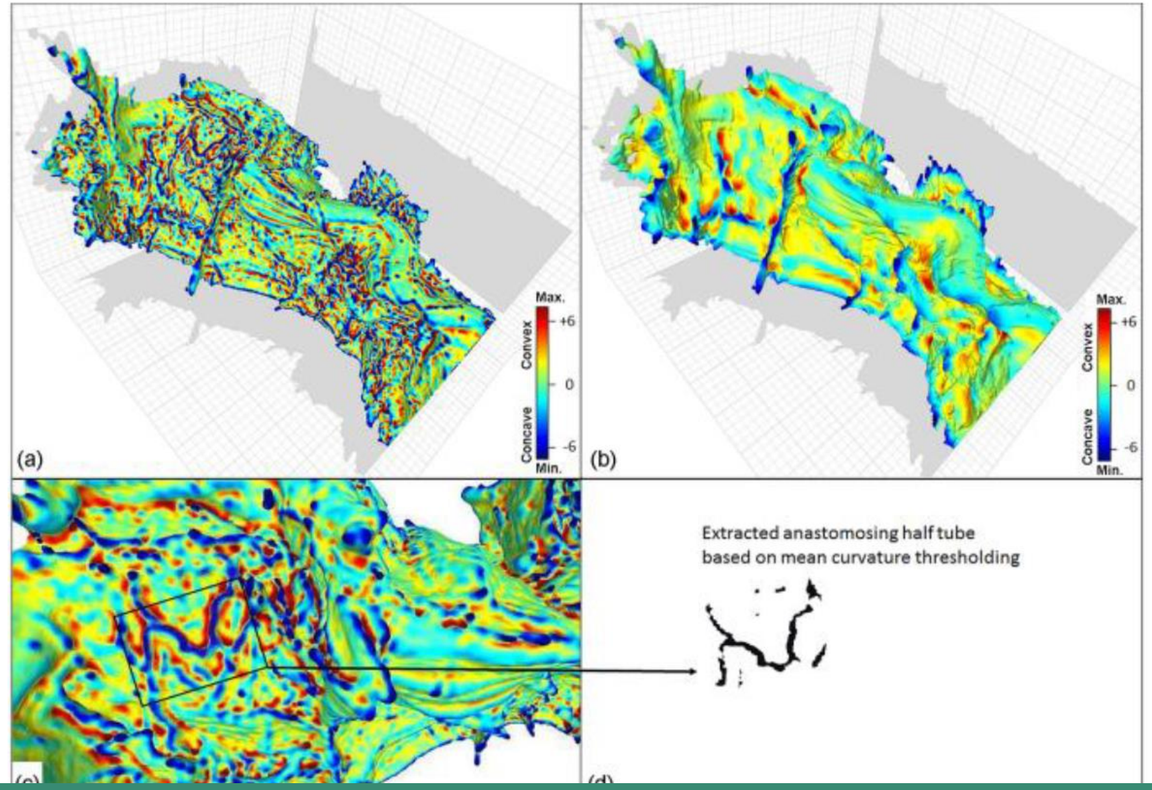


KARST & CAVE RESEARCH

Terrestrial Laser Scanning of Cave Systems







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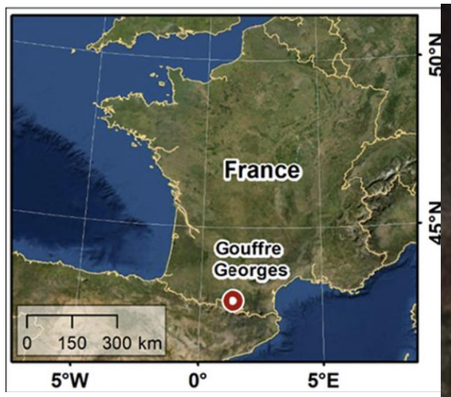
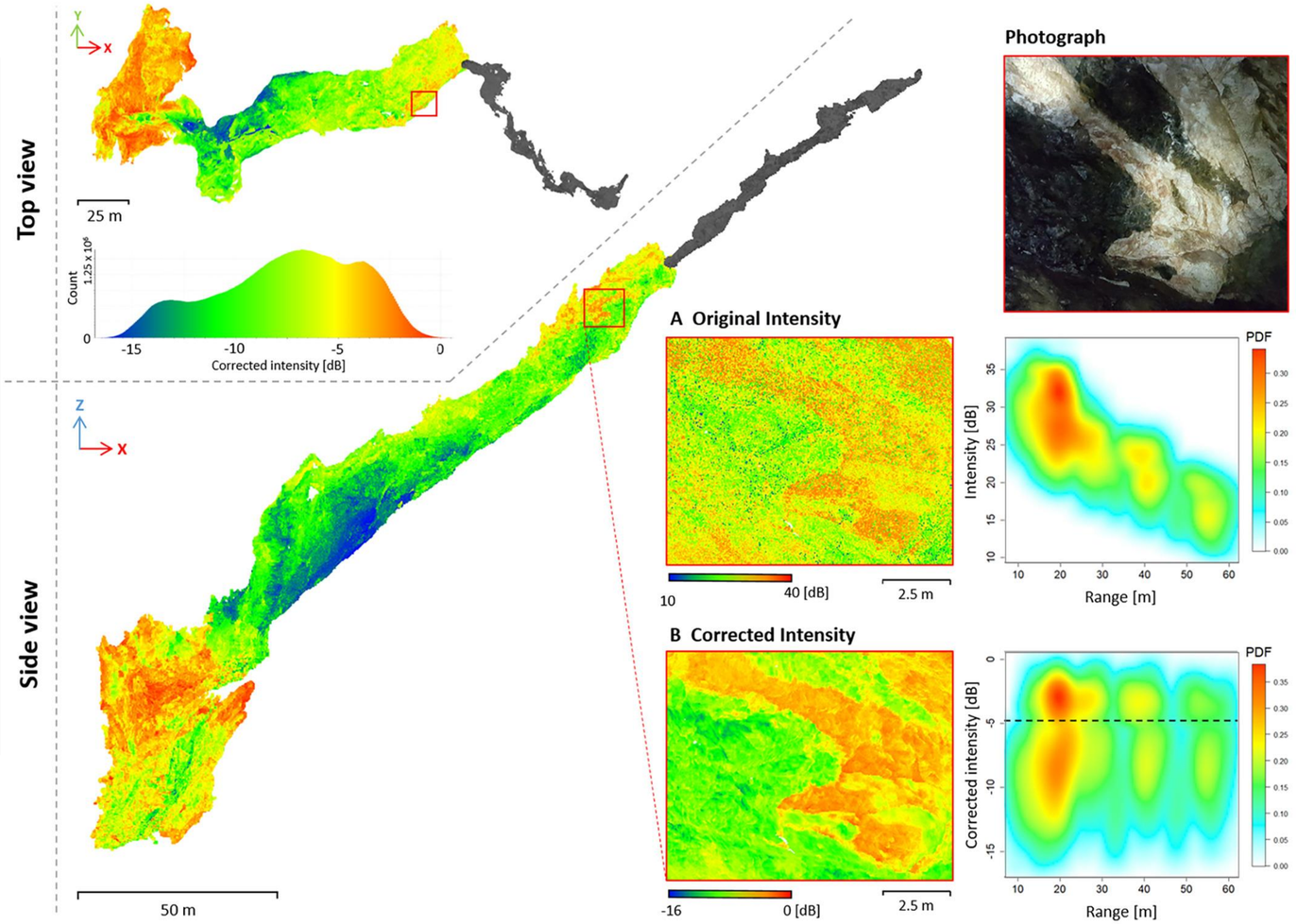
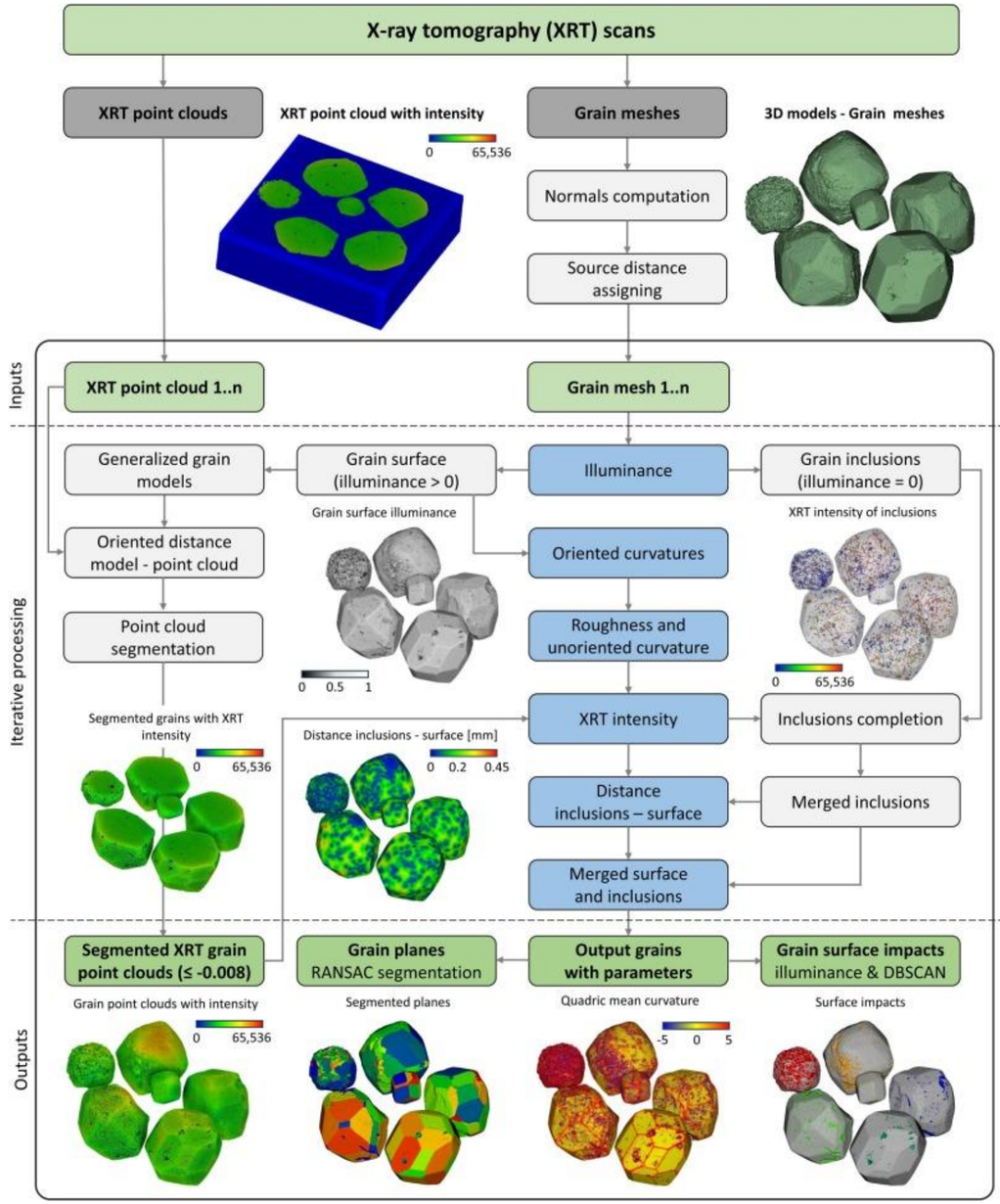




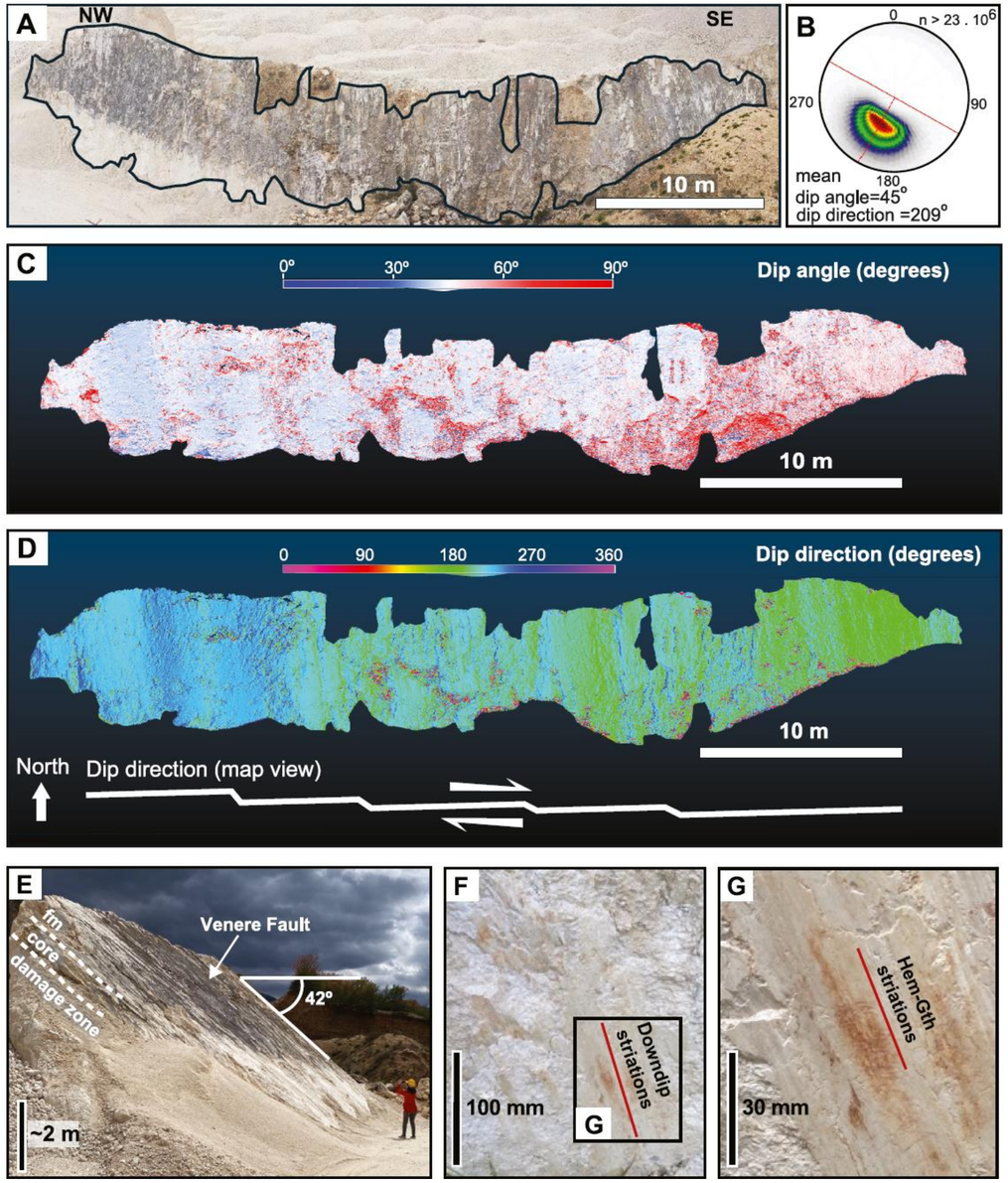
NOVÁKOVÁ, M., GALLAY, M., ŠUPINSKÝ, J., FERRÉ, E., ASTI, R., DE SAINT BLANQUET, M., BAJOLET, F., SORRIAUX, P. (2022). **Correcting laser scanning intensity** recorded in a cave environment for high-resolution lithological mapping: a case study of the Gouffre Georges, France. Remote Sensing of Environment, 280, 113210.

SEDIMENTOLOGY - HEAVY MINERALS – TECTONICS - PALAEOGEOGRAPHY

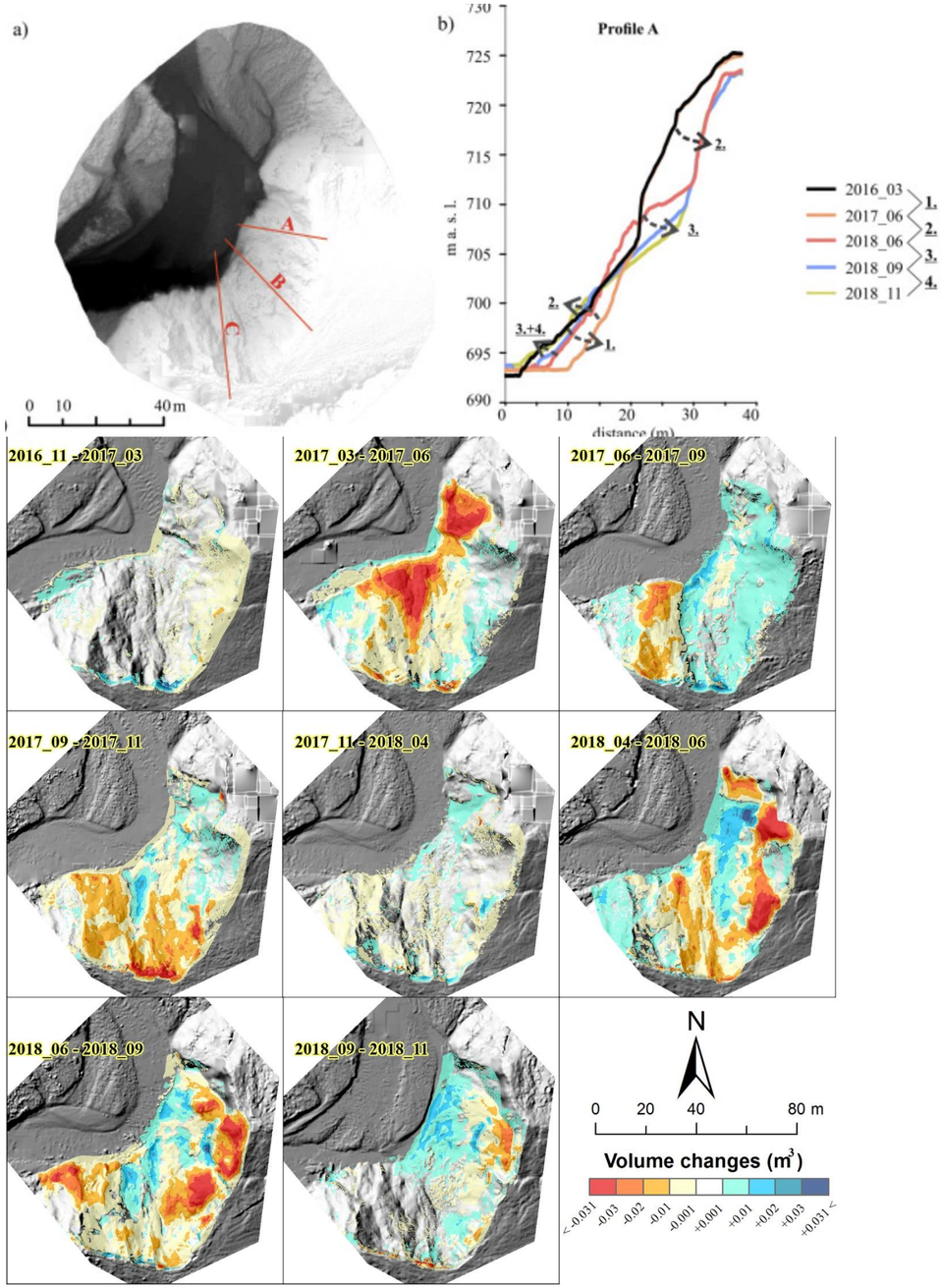
- Provenance analysis of Carpathian siliciclastic sediments
- Heavy mineral assemblages + zircon U–Pb geochronology
- Reconstruction of sediment sources and palaeodrainage systems
- Constraints on Flysh / Magura Basin evolution and tectono-sedimentary dynamics
- Linking surface processes with basin development and regional geodynamics
- Surface processes – sediment transport
- – basin evolution – tectonic implications.



Bónová et al. 2024: Sedimentary Geology, 467, 106652



ZAMANI, N., SATOLLI, S., MURPHY, M., DEMORY, F., PACE, B., GATTACCECA, J., KAŇUK, J., **NOVÁKOVÁ, M.**, GOTTARDI, R., FERRÉ, E. C. (2025). Record of seismic slip in carbonates: insights from the Venere Fault during the 1915 Avezzano earthquake (Mw 7.0), Central Italy. Journal of Structural Geology, 105421.



RUSNÁK, M., **KAŇUK, J.,** KIDOVÁ, A., **ŠAŠAK, J.**, LEHOTSKÝ, J., PÖPPL, R., **ŠUPINSKÝ, J.** (2020). Channel and cut-bluff ..a. Science of The Total Environment, 733, 139409.

EARTH-SURFACE & URBAN CLIMATE RESEARCH

High-Resolution Urban Climate Analysis Using Geospatial Data

European Space Agency

Research Objective: Quantify spatial variability of **urban heat island (UHI)** and evaluate the cooling effects of urban vegetation

.

Integrated Data Sources

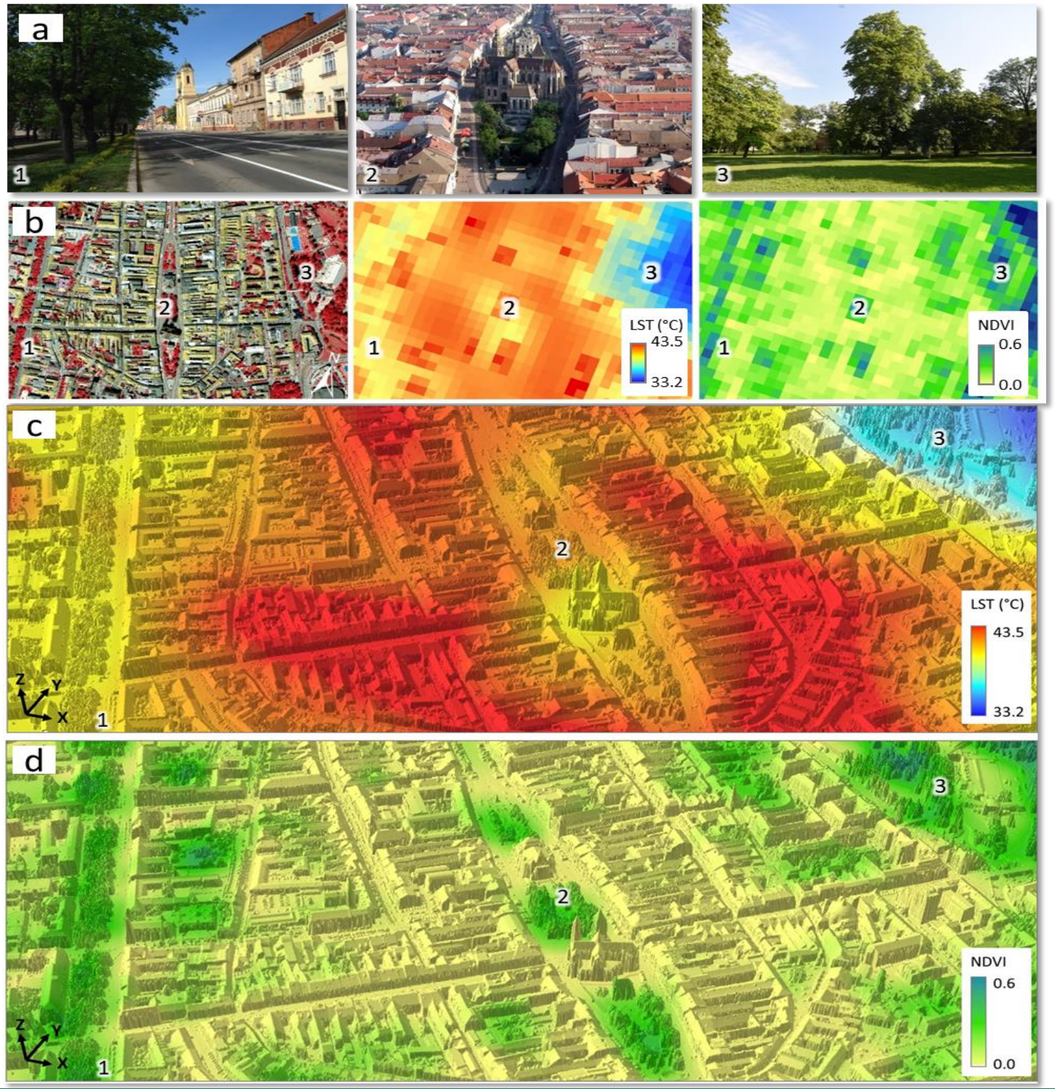
- **Satellite EO:** Sentinel-2, Landsat thermal imagery
- **Airborne data:** LiDAR and multispectral mapping
- **Terrestrial laser scanning:** detailed 3D vegetation structure
- **3D city models:** LoD2 building representation

Analytical Framework

- Surface parameter extraction (NDVI, albedo, emissivity)
- 3D solar radiation modelling in **GRASS GIS (v.sun)**
- Physically-based **land surface temperature modelling (r.lst)**

Goal

Link urban morphology, vegetation structure, and radiation balance to local thermal conditions.



EARTH-SURFACE & URBAN CLIMATE RESEARCH

High-Resolution Urban Climate Analysis Using Geospatial Data

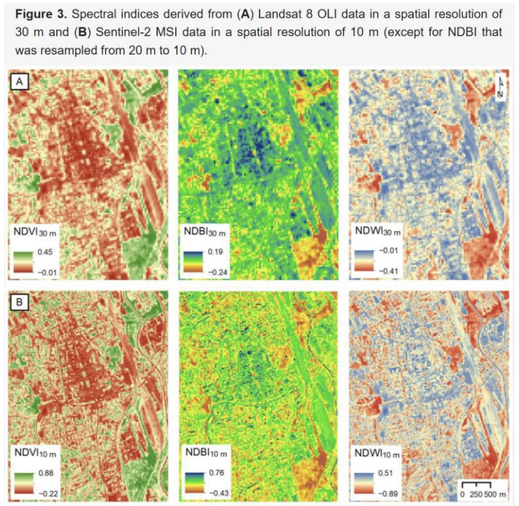
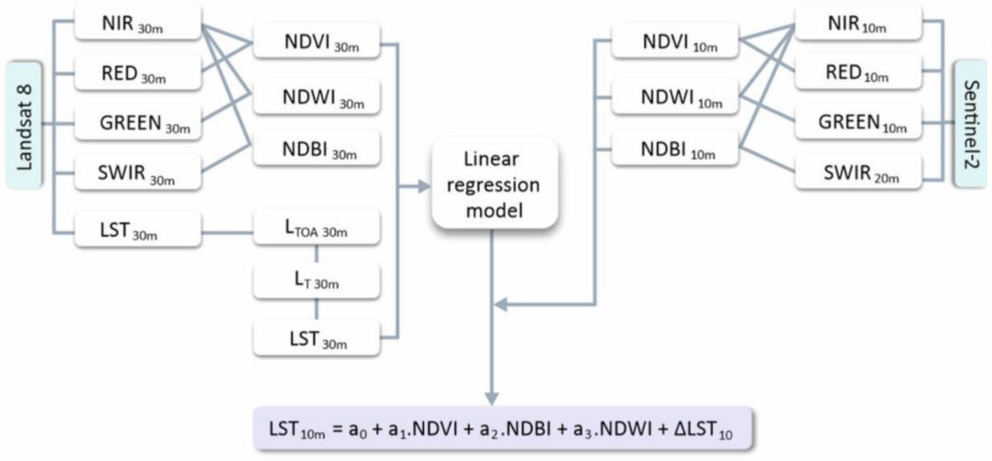
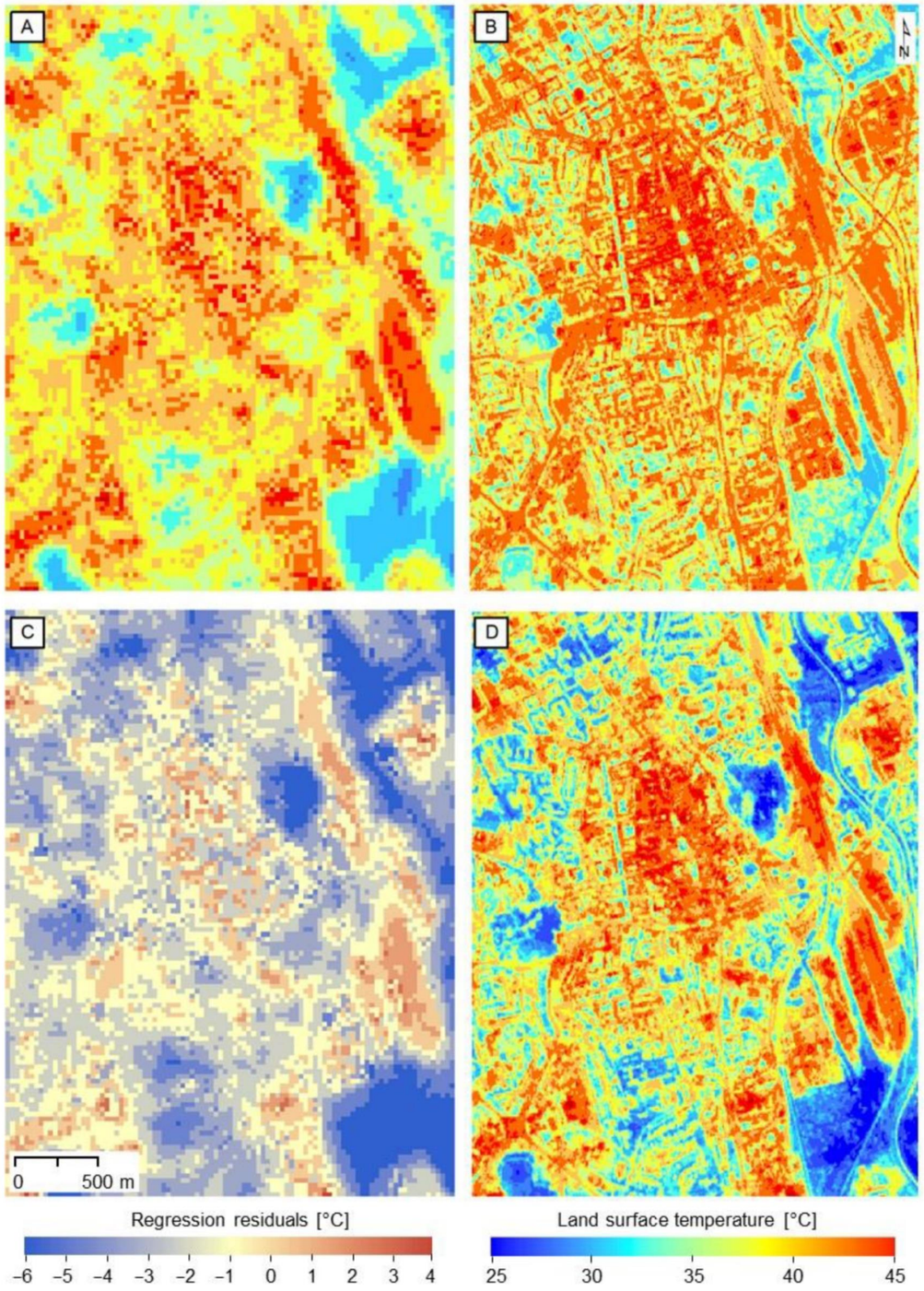


Figure 3. Spectral indices derived from (**A**) Landsat 8 OLI data in a spatial resolution of 30 m and (**B**) Sentinel-2 MSI data in a spatial resolution of 10 m (except for NDBI that was resampled from 20 m to 10 m).

Satellite data: Increasing the resolution of Landsat thermal data with Sentinel 2 spectral indices





ONAČILLOVÁ, K., GALLAY, M., PALUBA, D., PÉLIOVÁ, A., **TOKARČÍK, O., LAUBERTOVÁ, D.** (2022). Combining Landsat 8 and Sentinel 2 data in Google Earth Engine to derive higher resolution land surface temperature mapsin urban environment. Remote Sensing 14 (16), 4076.

EARTH-SURFACE & URBAN CLIMATE RESEARCH

High-Resolution Urban Climate Analysis Using Geospatial Data

Physically-based modelling of land surface temperature in high-res.

Methodological Approach

- High-resolution **DTM/DSM (0.5 m)** derived from LiDAR
- Vegetation structure integrated into radiation models
- Heat transfer coefficients for urban materials
- Satellite LST used for calibration and validation

Key Advantage:

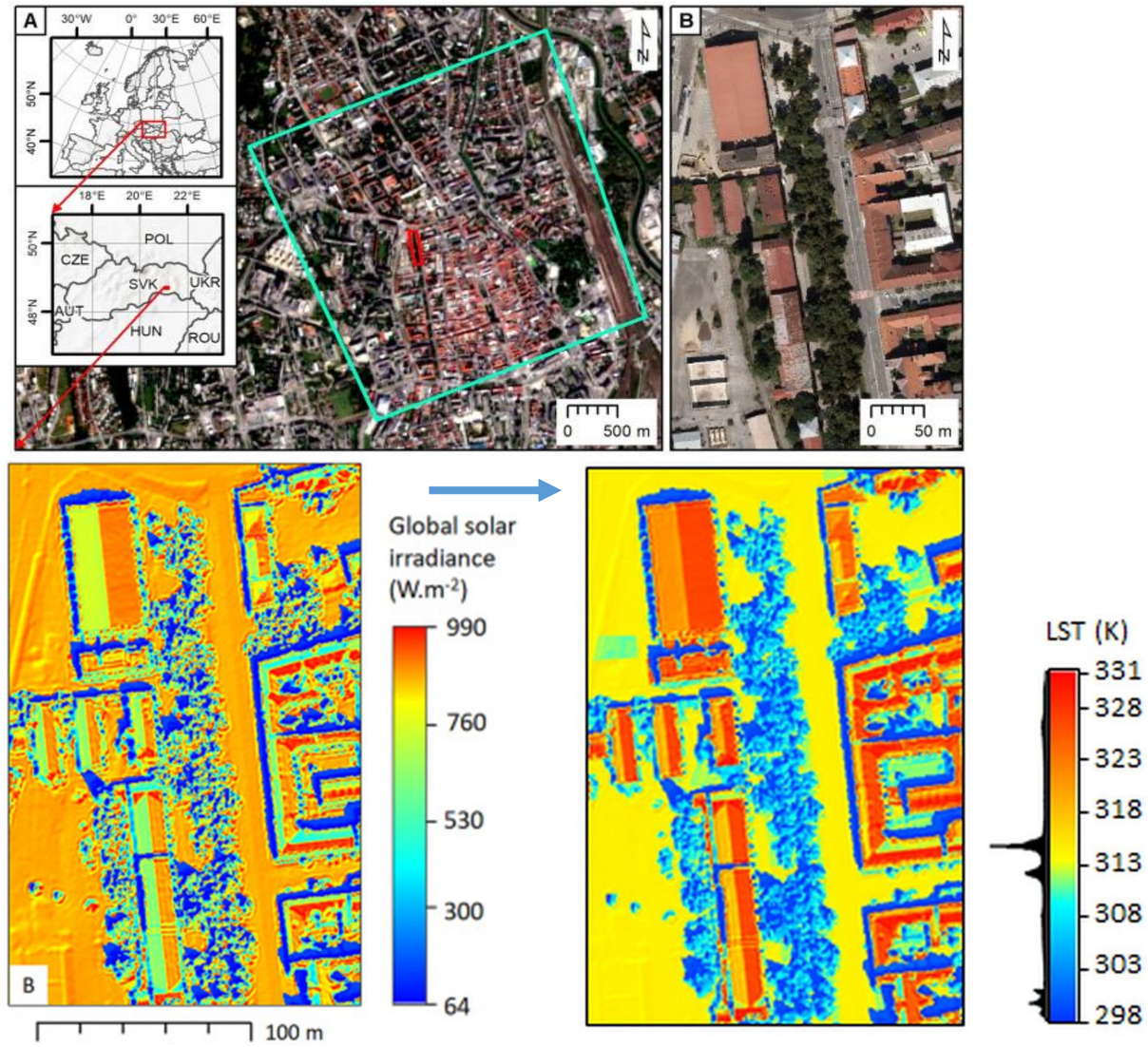
Assuming daylight and clear sky - no need for thermal mapping and sub-meter urban detail.

Applications

- Mapping thermal hotspots
- Quantifying cooling effect of urban greenery
- Evaluating climate-adaptation strategies in cities

Case Study

Urban microclimate modelling in **Košice and Rome**



HOFIERKA, J., GALLAY, M., ONAČILLOVÁ, K., HOFIERKA, J. Jr. (2020). Physically-based land surface temperature modeling in urban areas using a 3-D city model and multispectral satellite data. **Urban Climate**, 31, 100566.

MAFIS

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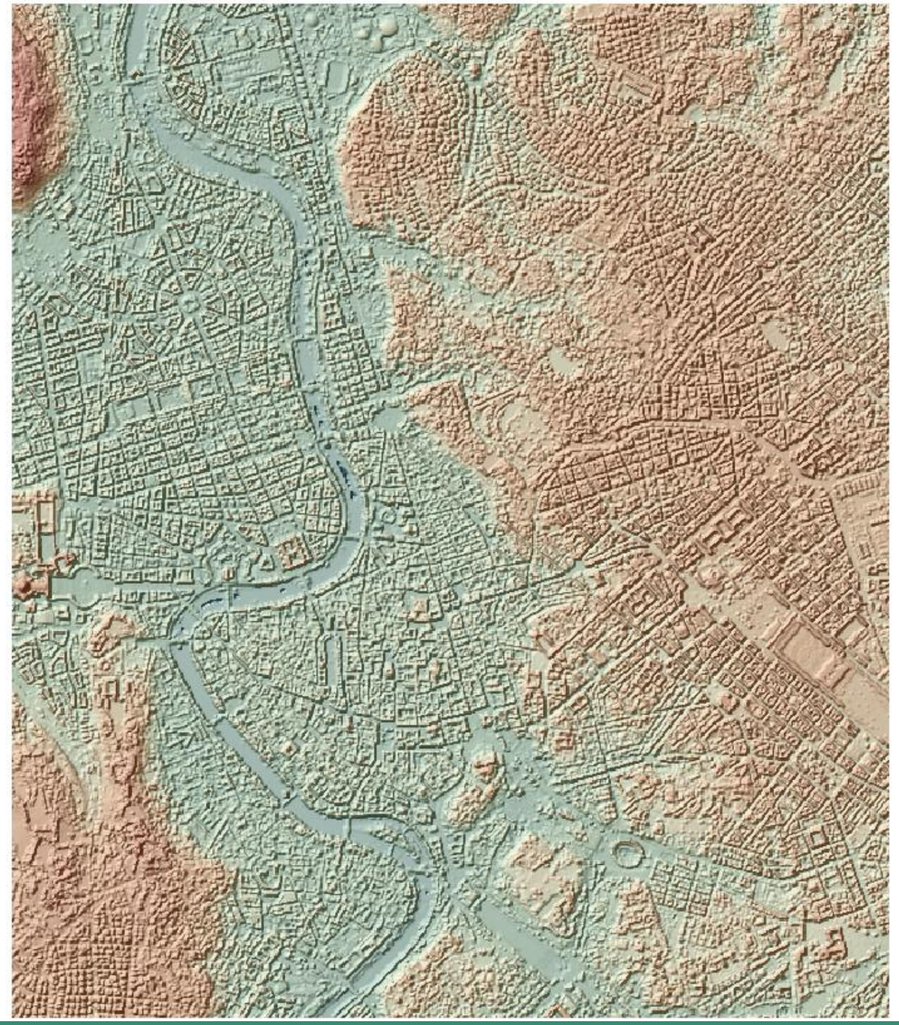
European Space Agency

- Calculation of Land Surface Temperature in cities using the example of Košice and Rome through custom, physically-based models and 3D models

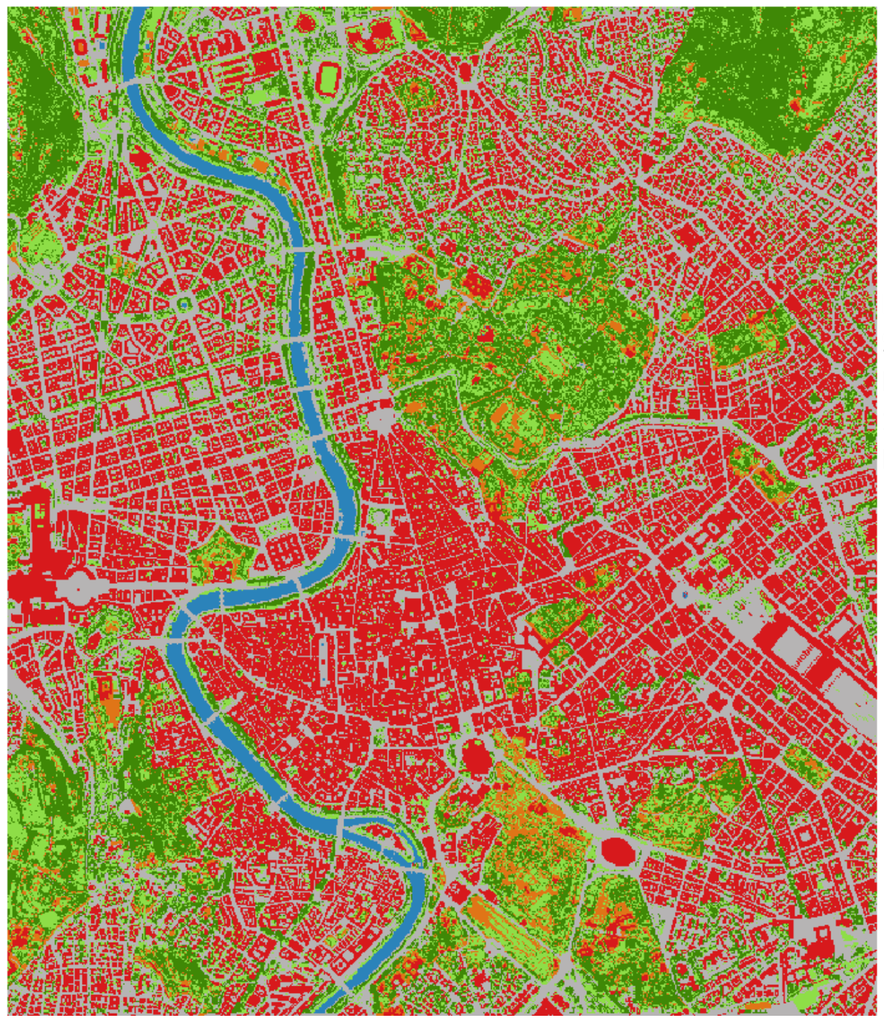


Altitude of digital surface model

Altitude (m a.s.l.)

- 0
- 75
- 100
- 110
- 140
- 237

Digital surface model
Height and hillshade
Source: Lidar
Resolution: 0.5 m
Date & Time: 2020?



The City of Rome

Land cover
Source: WorldView
Date & Time: 4 September 2021, 11:25 CET (9:25 GMT)
Resolution: 0.3 m

- Trees
- Shrubs and low vegetation
- Bare soil
- Asphalt
- Buildings
- Water

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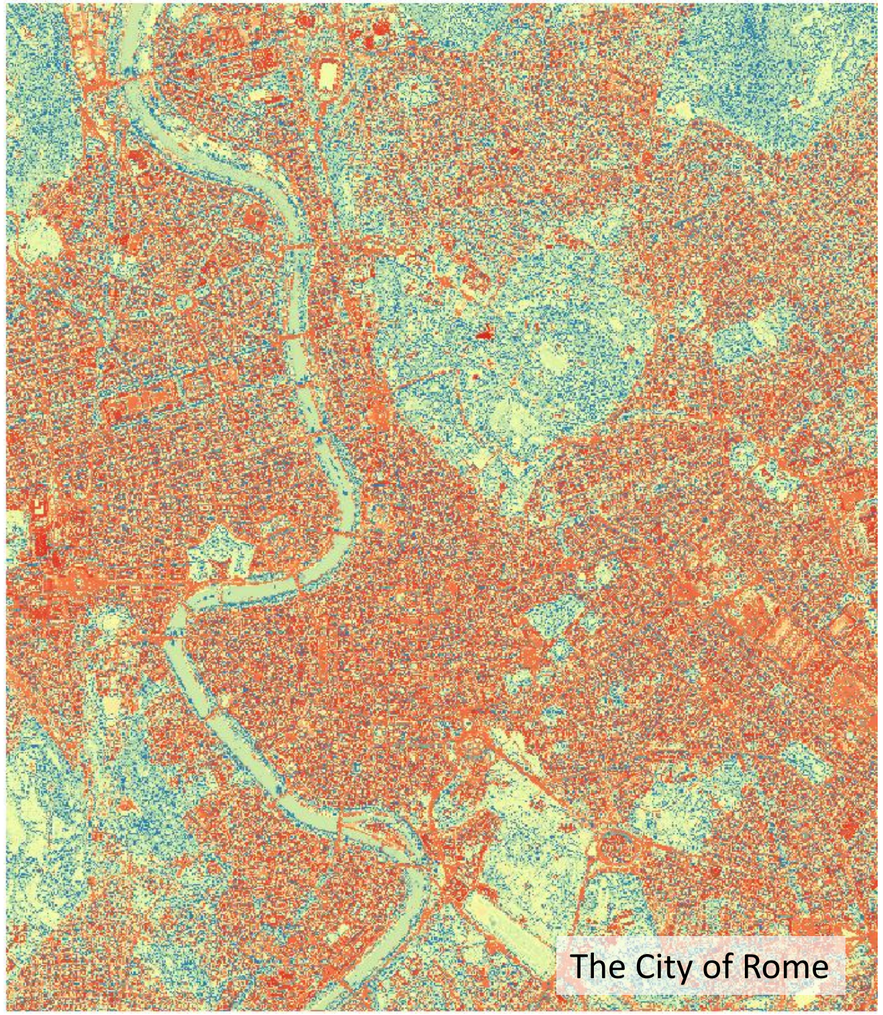
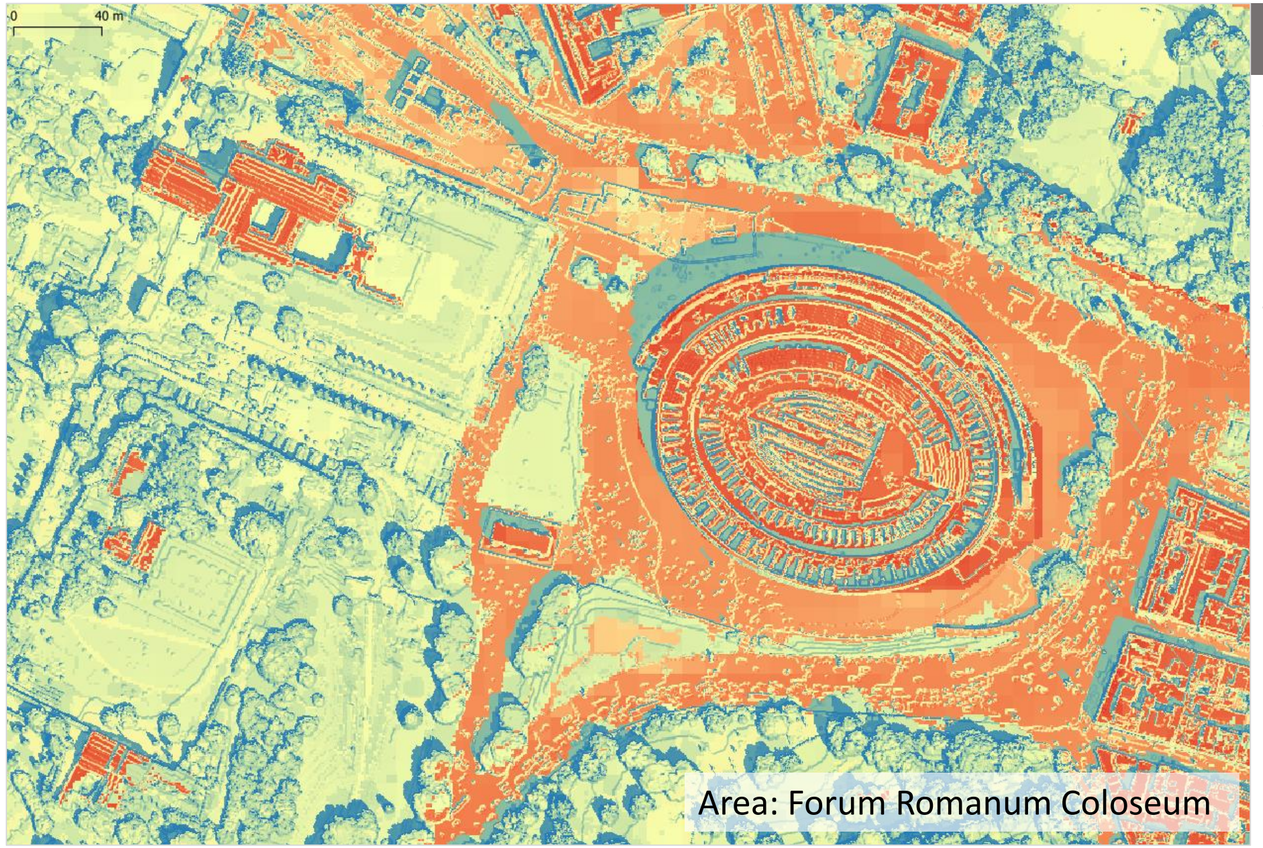
Modelled land surface temperature (°C)

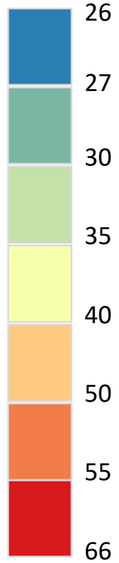




The City of Rome

Air temperature: 27.4°C
Date & Time: 4 June 2021, 11:00 CET (9:00 GMT)

Modelled land surface temperature (°C)
Resolution: 0.5 m



URBANA

Development and Verification of Urban Analytics

European Space Agency

Modelling Urban Thermal Environment

Use of thermal comfort indices:

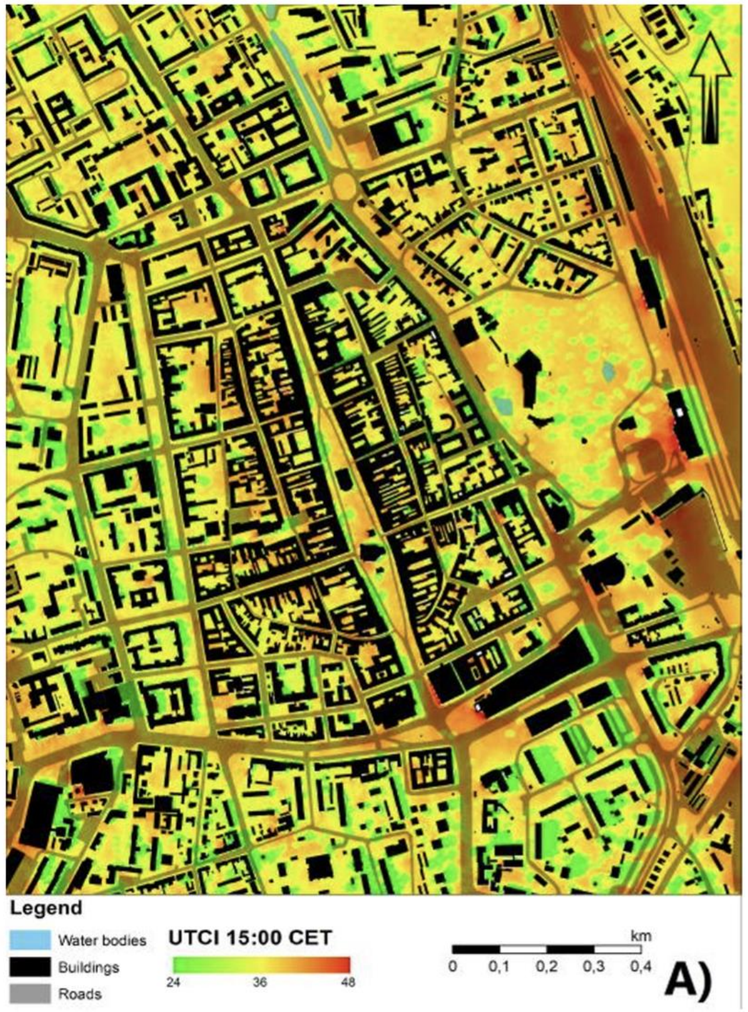
- **PET** – Physiological Equivalent Temperature
- **SET** – Standard Effective Temperature
- **UTCI** – Universal Thermal Climate Index

Analytical Inputs

- Land surface temperature modelling
- Urban morphology and shading effects
- Vegetation distribution and density
- ENVI-met microclimate model
- meteorological forcing data from hourly SYNOP observations at the Košice airport.

Scientific Objective:

- **Assess how urban design and vegetation influence human thermal exposure**.
- Supports **urban climate adaptation strategies** and mitigation of extreme heat events.



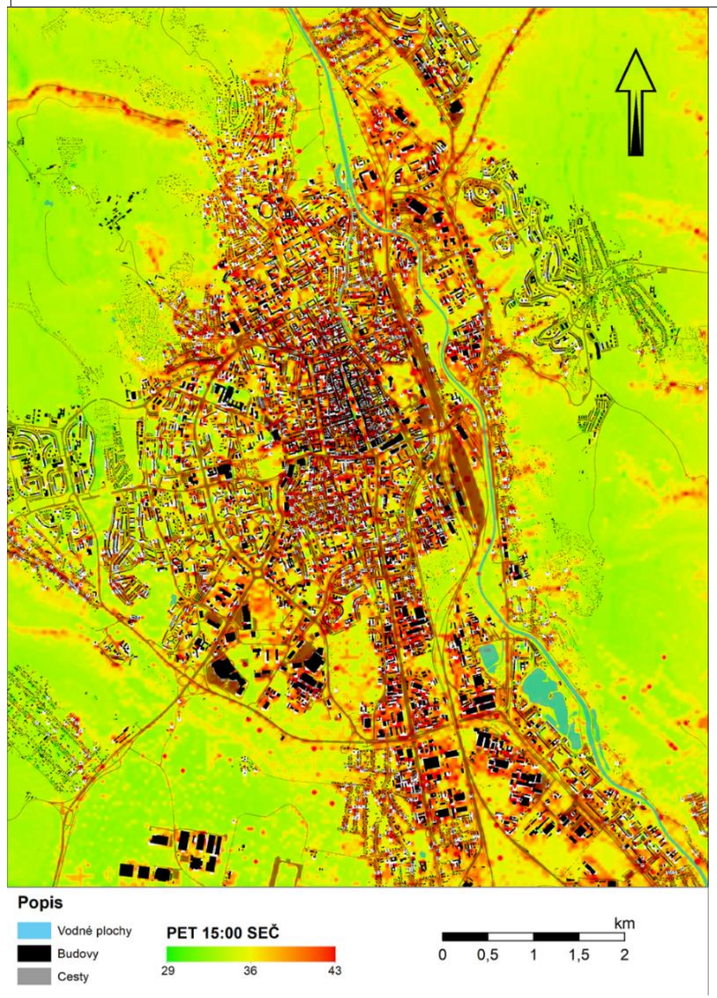
ONAČILLOVÁ, K., FEDOR, T., GALLAY, M., ŠAŠAK, J., BOGĽARSKÝ, J., KAŇUK, J., SALAJOVÁ, N. (2026). Local climate zones and diurnal surface heating in a Central European city: A comparison of Landsat, ECOSTRESS, and ENVI-met with in situ measurements in Košice (Slovakia). Remote Sensing Applications: Society and Environment, 41, 101933.

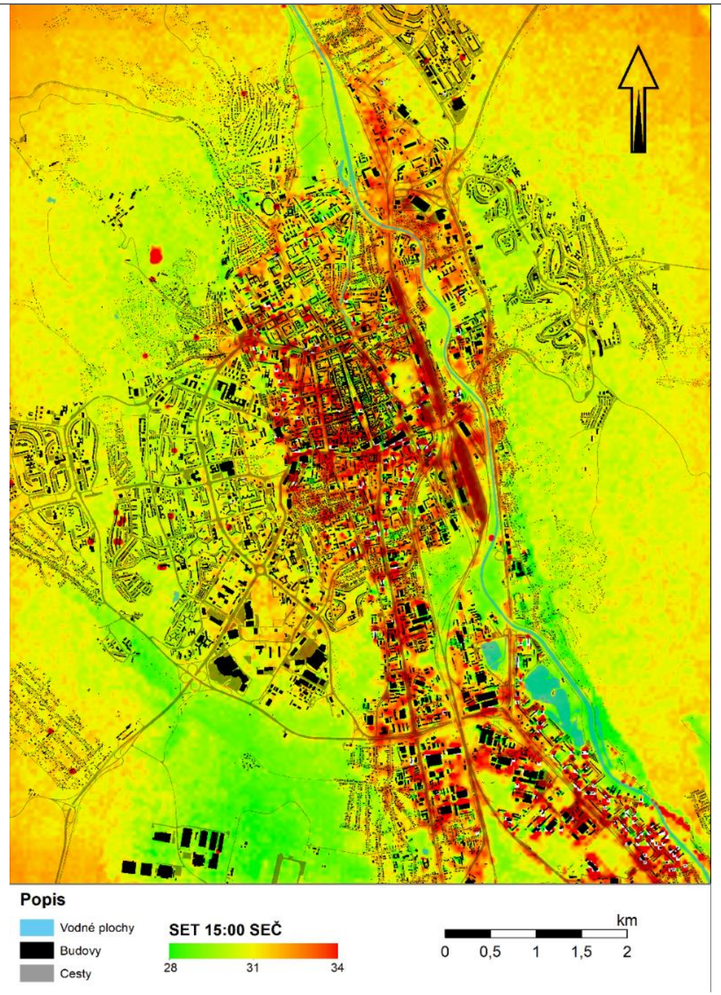
FEDOR, T. , HOFIERKA, J. 2025. Estimating heat stress in the urban centre of Košice using ENVI-met and high-resolution surface data GEOGRAPHIA CASSOVIENSIS XIX .

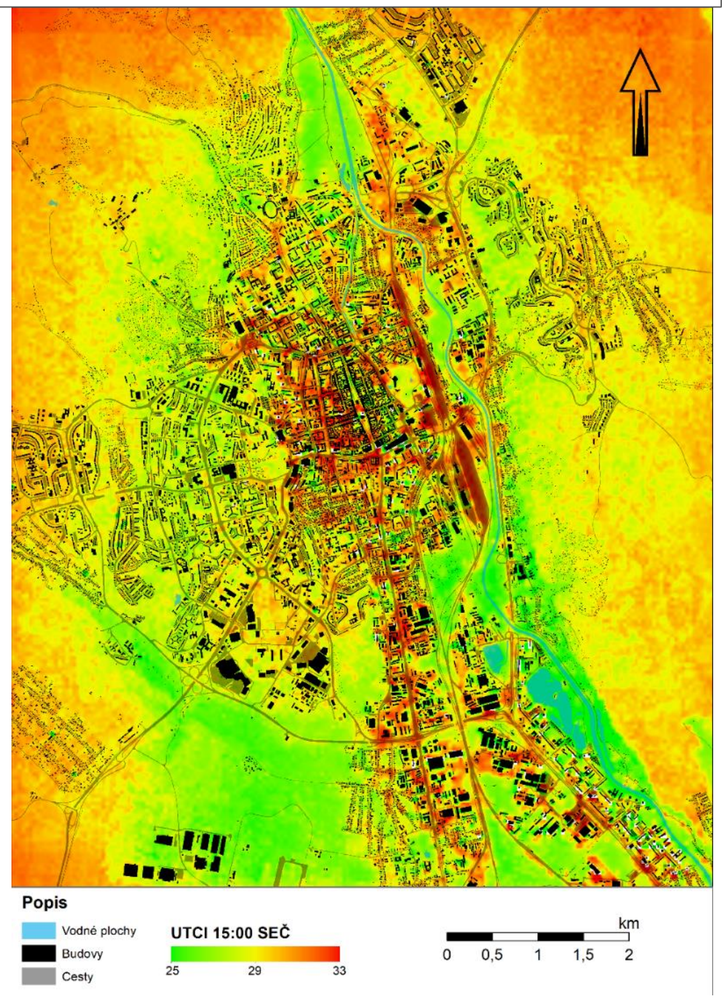
URBANA

Development and Verification of Urban Analytics

- Modelling heat stress on urban population in the cities Košice and Bratislava





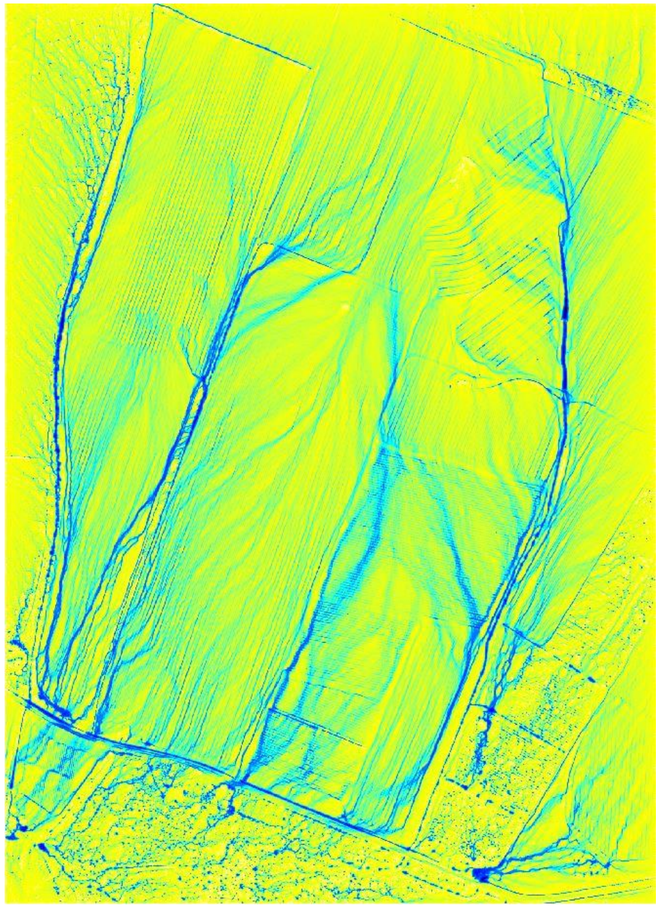


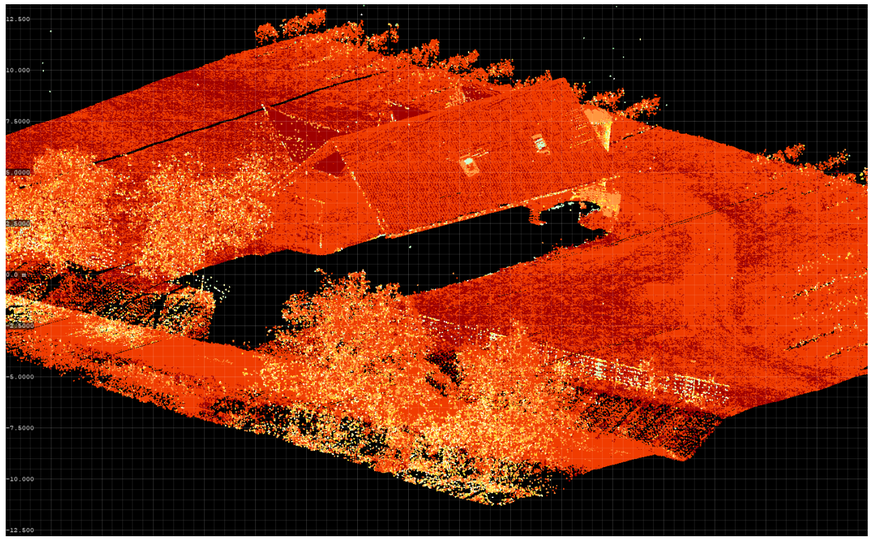
Assessing human thermal comfort in the city of Košice using the PET (Physiological Equivalent Temperature), SET (Standard Effective Temperature), and UTCI (Universal Thermal Climate Index) indices

TOKAJGIS

Transport of sediments and optimization of procedures for vine nutrition

- INTERREG funded
- HUSK Development of webGIS platform based on big-geodata for the Tokaj Wine Region foster cross-border collaboration





EARTH-SURFACE & URBAN CLIMATE RESEARCH

Hydrological Hazard Modelling in Urban Landscapes

Flash-Flood Simulation

- High-resolution 2D hydrological modelling using **GRASS GIS (r.sim.water)**
- CFD 3D modelling in Delft 3D

Input Data

- LiDAR-derived terrain models
- Surface roughness and land cover
- Extreme rainfall scenarios

Outputs

- Water depth and flow accumulation maps
- Identification of high-risk urban areas
- Evaluation of mitigation measures

Applications

- Urban flood hazard assessment and support for **civil protection planning**.

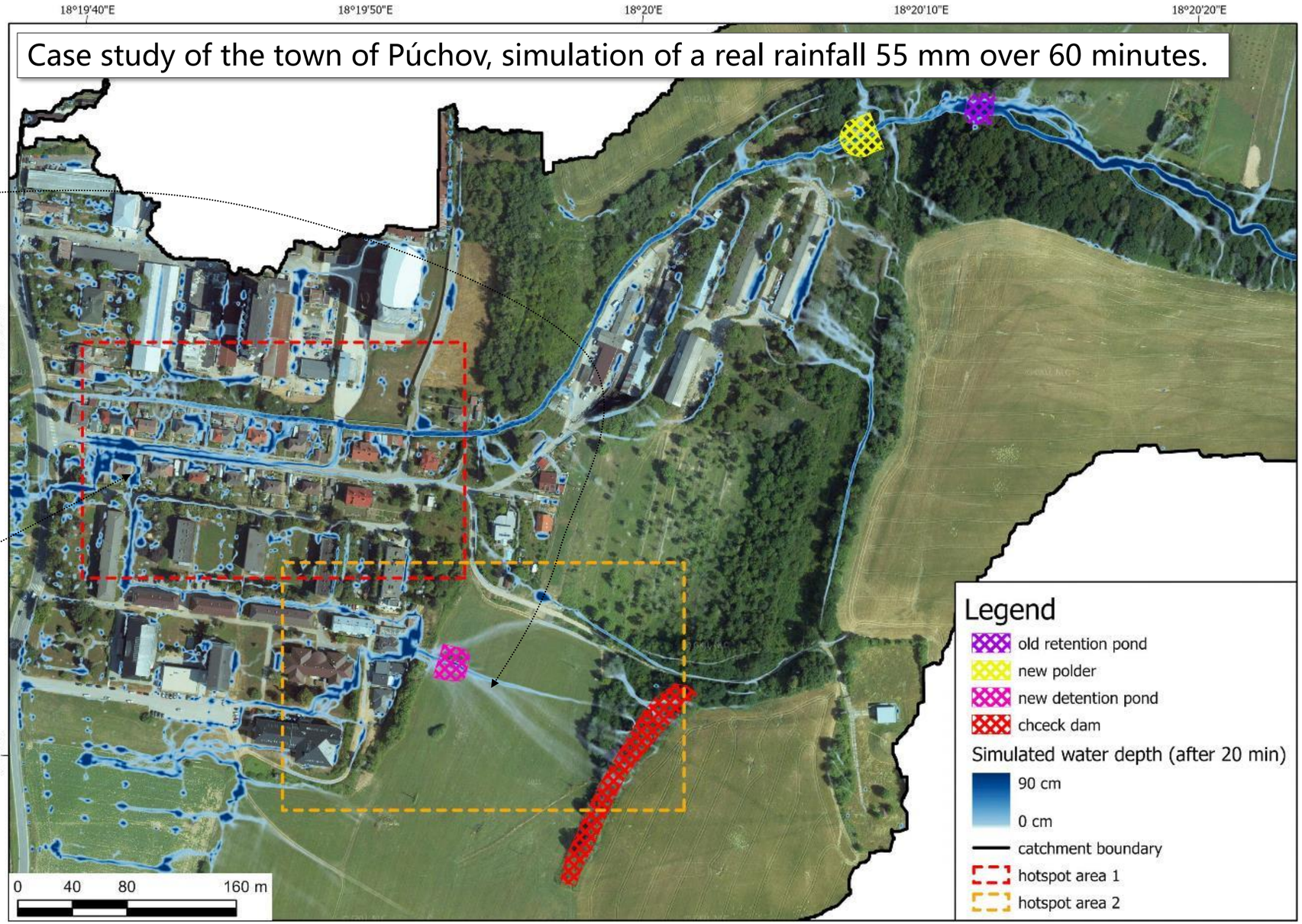
EARTH-SURFACE & URBAN CLIMATE RESEARCH

Consultancy projects

- Simulating the flooding after **water dam breaching for Košice city** civil protection
- **Carbon emission strategy** for Košice city
- **Training in GIS** for Košice self-government region, Deutsche Telekom IT Solutions Slovakia

TOKARČÍK, O., HOFIERKA, J. (2024). Designing flash flood control measures for urban areas using the Monte Carlo water flow simulation. Geomatics, Natural Hazards and Risk, 15, 1, 2361806.

Frequent flash floods in the summer.
Water concentrates on a gentle slope.
Flooding nearby streets and houses.



Adopted from: Tokarčík and Hofierka (2024)

IRSSS 2026

INTERNATIONAL
REMOTE SENSING
SUMMER SCHOOL

THANK YOU

for your attention !

SEE MORE. UNDERSTAND BETTER. MANAGE SMARTER.

PAVOL JOZEF ŠAFÁRIK UNIVERSITY IN KOŠICE

Università degli Studi di Cagliari

ISTITUTO NAZIONALE DI GEOFISICA E VULCANOLOGIA

INSTITUTE OF GEOGRAPHY SLOVAK ACADEMY OF SCIENCES

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