

→ 7th ADVANCED TRAINING COURSE ON LAND REMOTE SENSING

4–9 September 2017 | Szent István University | Gödöllő, Hungary



LAND REMOTE SENSING IN HUNGARY

AN INCOMPREHENSIVE OVERVIEW

Dániel Kristóf



*Government Office of the Capital City Budapest
Department of Geodesy, Remote Sensing and Land Offices
(formerly: FÖMI – Institute of Geodesy, Cartography and Remote Sensing)*

Overview

- History: important highlights from the past
- Current operational projects (nation-wide)
- Panorama: Major Hungarian players in Land Remote Sensing
- Wrap-up, conclusions and outlook



HIGHLIGHTS FROM THE PAST

Highlights from the past: Beginnings (-1980)

- Coordination:
 - Committee for Technological Development (OMFB)
 - Ministry of Agriculture (MÉM)
 - HAS Interkosmos Council (MTA-IKT)
 - Member, RS promoter: **Pál Stefanovits** (Gödöllő!)
- Research and development
 - Budapest Technical University (BME)
 - Eötvös Loránd University (ELTE)
 - HAS Institute for Computer Science and Control (SZTAKI)
 - Institute of Geodesy (FÖMI) – Cosmic Geodetic Observatory (KGO)
 - *first working group dedicated to RS (1972/1976)*
- Information exchange
 - NGOs: Hungarian Astronautical Society, Society for Geodesy and Cartography



Highlights from the past: INTERKOSMOS

- Cooperation of socialist countries in the space domain
- Example: Preparation of the Hungarian cosmonauts for Earth Observation tasks (1978-80)



Argentino-tó
(Argentina)

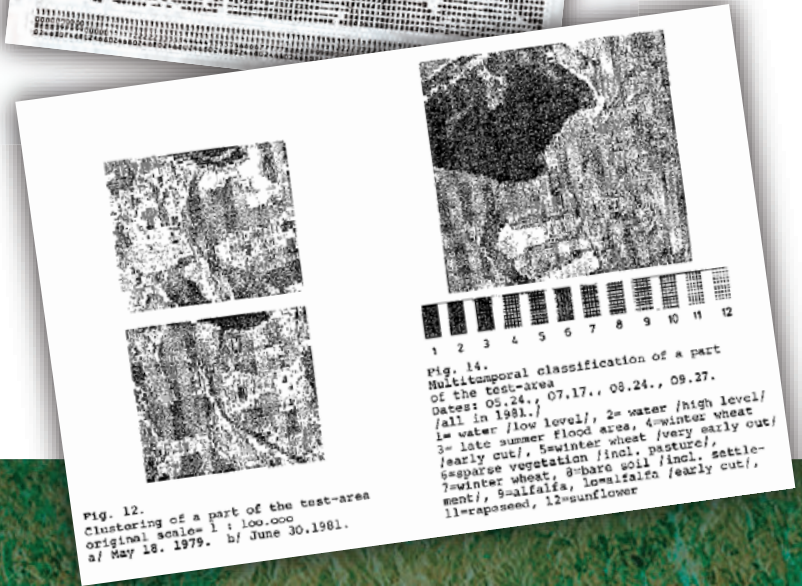
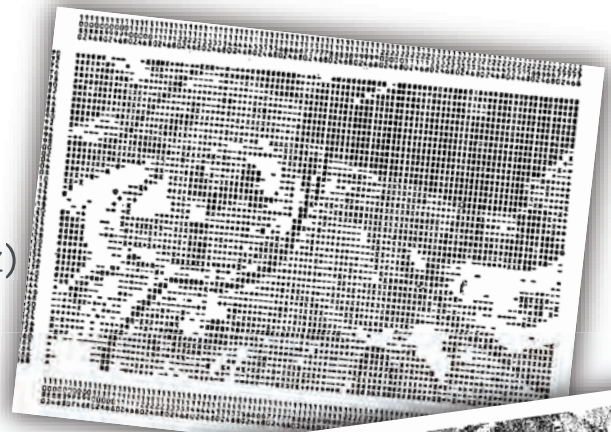
A Dél-Andok főláncának vonulatai és a hegység chilei, valamint patagóniai előtere tanulmányozható a felvételen. Majdnem az egész területet hó borítja, csak a legalacsonyabb (kb. 300 m alatti) részek, a hegyi tavak partvidéke és a folyóvízcsapások csupaszok még keleten. Az Andok argentinai oldalán a hidegebb, kontinentális jellegű éghajlat miatt a téli éjszakai hőmérséklet jóval alacsonyabban húzódik, mint a hasonló földrajzi szélességen lévő nyugati, egyike, óceáni klímájú szigeteken és hegységeken, ahol a hő még csak 600...850 m felett marad meg. A Dél-Andok trópusi, nagy magasságra emelkedő csúcsai (Cerro Murad 3600 m, Cerro Beronand 3270 m) jól kirajolódnak. Az ábrán az egyik legmagasabb északkeleti térsége a hegységi eljegesedés. A csúcsok össze-

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Highlights from the past: RS as independent discipline

- 1980: FÖMI declared responsible for RS activities by law
 - For resolutions < 80m (below 50m: classified)
 - >80m: Hungarian Meteorological Service (OMSz)
- FÖMI Department of Remote Sensing
 - From former FÖMI / KGO personnel and other institutions (SZTAKI, ELTE)
 - Own developments - due to restrictions
- Long-term RS strategy, operational developments
 - Hungarian Agricultural Remote Sensing Program (MTP/HARSP)
 - Long-term contracts among FÖMI, Ministry of Agriculture and the Comm. for Technolog. Dev.



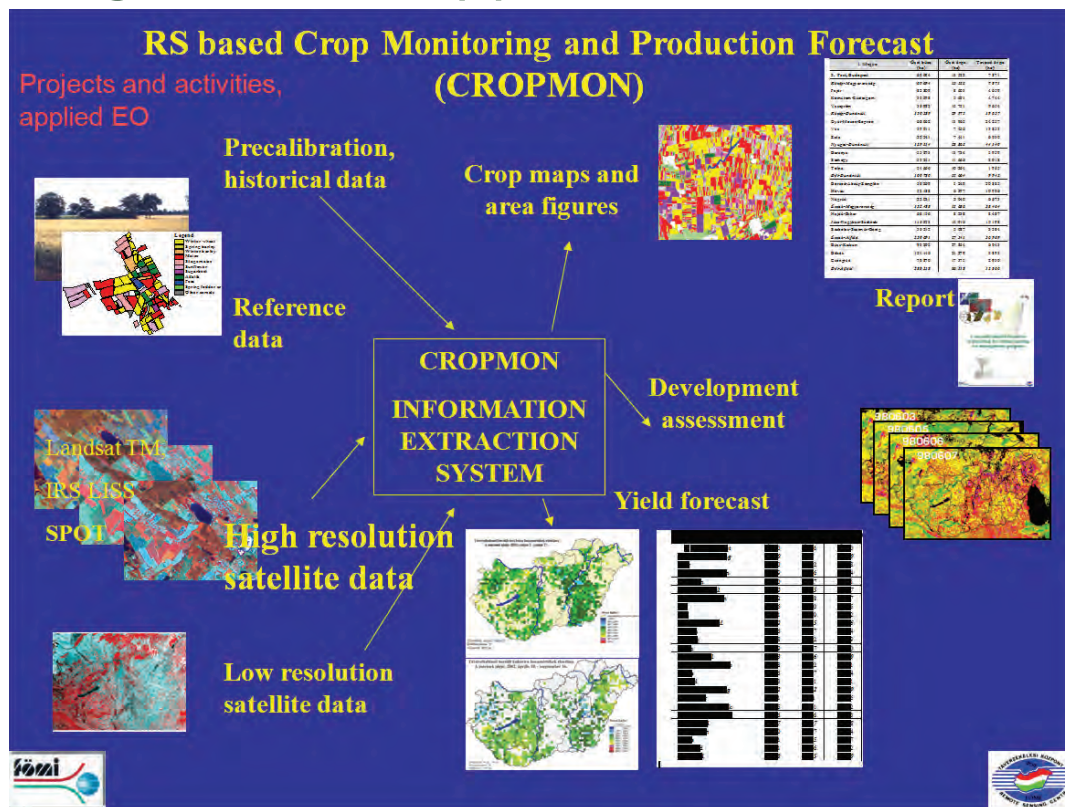
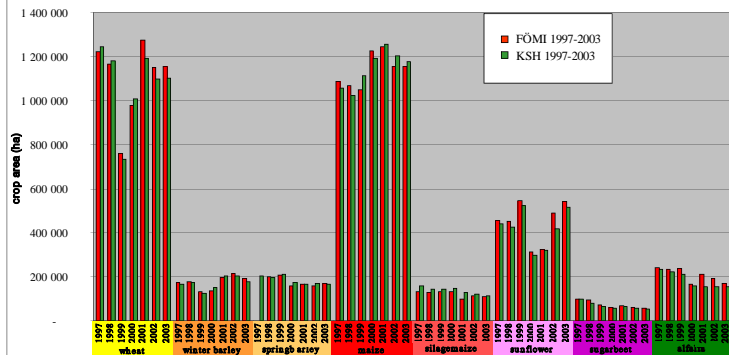
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Highlights from the past: Agricultural applications

CROPMON (NÖVMON)

- first operational RS programme serving practical needs
- huge amount of R&D (300 man-years)
- operational from 1997 to 2003
- basis for current operational programmes

Areas of the main crops in 1997-2003 in Hungary
by FÖMI RSC and CSOH



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Highlights from the past: Environmental applications

CORINE

- First project-level cooperation with Western Europe (1992-)
- Basis for current environment-related RS activities
- Satellite image preprocessing and hard copy generation (1993-94)
- Hungarian CORINE Land Cover mapping (1994-97)
- Application of CLC in modelling runoff and phosphorus pollution in a river catchment (PHARE, 1998)
- CORINE Land Cover 1:50 000 (1998-2004)

European CORINE Land Cover in Hungary



Input: Projects and activities, applied EO

Orthorectified Landsat TM (ETM) satellite images

Method:


Visual interpretation with computer assistance
use of ancillary information (maps, air-photos), field checking

Output:

Digital database including 44 categories in five groups:

- artificial surfaces
- agriculture
- forest and semi-natural vegetation
- wetlands
- water bodies

CLC90, CLC2000, CLC-changes



MADOP: National Orthophoto Programme

Regular aerial campaigns and
orthophoto generation for the
whole country since 2000
(EU agricultural subsidies)



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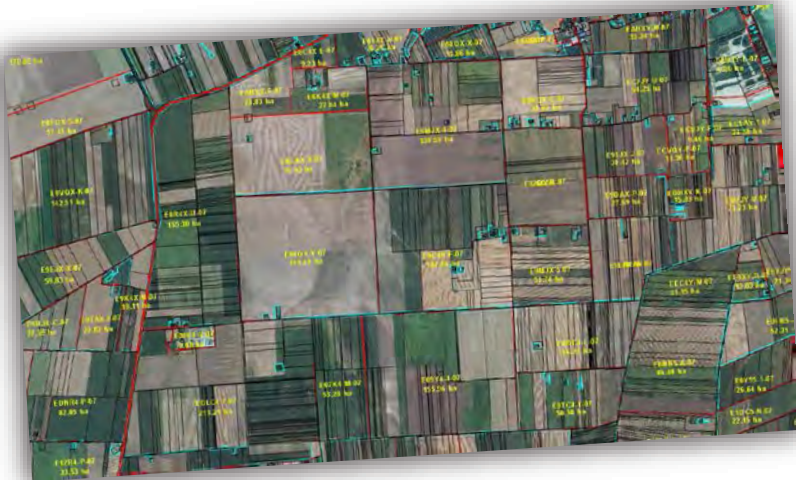
A satellite map of a river valley, likely the Danube, showing a winding river through a landscape of green vegetation and brownish soil. The text "AND TODAY..." is overlaid in white.

AND TODAY...

Current operational RS projects at GOCCB-DGRSLA (FÖMI)

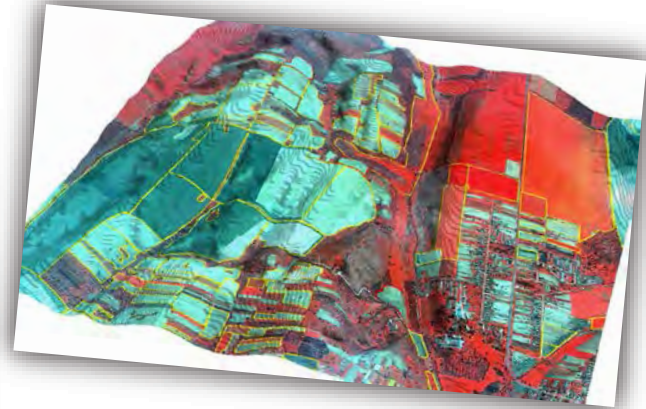
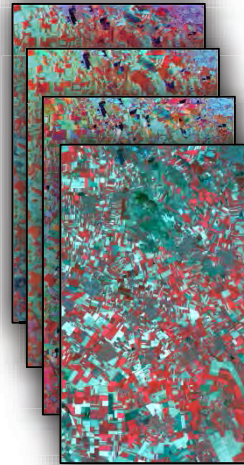
- Land Parcel Identification System (MePAR)

- GIS, mandatory for the administration of agricultural EU subsidies
- Operational since 2004
- Continuous updating based on orthophotos and VHR imagery



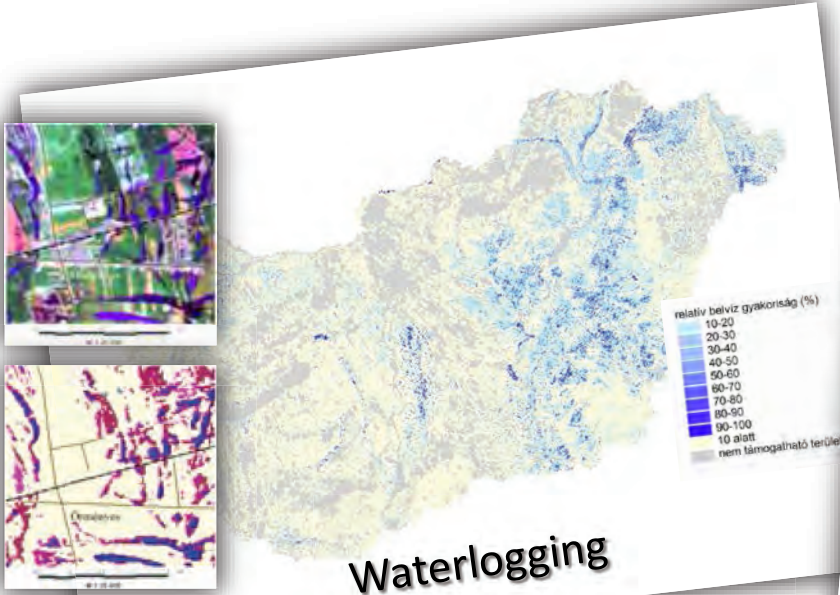
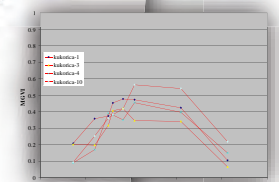
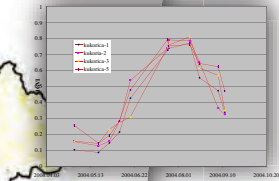
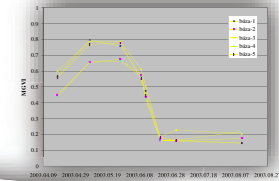
- Control of Agricultural Subsidies with Remote Sensing (TámELL)

- Operational since 2004
- Based on time series of HR and VHR satellite imagery

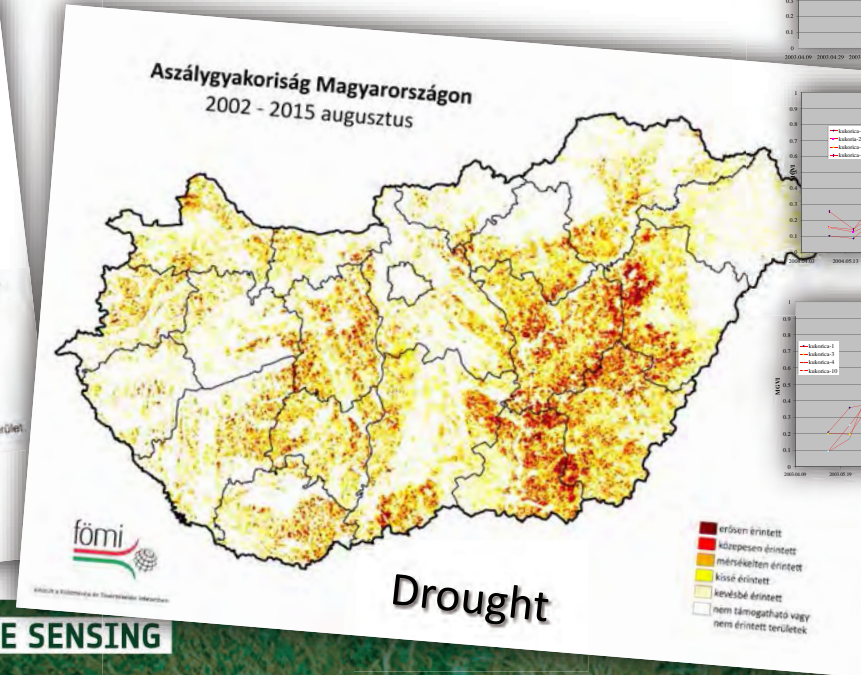


Current operational RS projects at GOCCB-DGRSLA (FÖMI)

- Agricultural Risk Management System (MKR)
 - Operational since 2014
 - Integrated governmental system to assess loss compensation requests
 - Operational provision of waterlogging / inundation and drought products



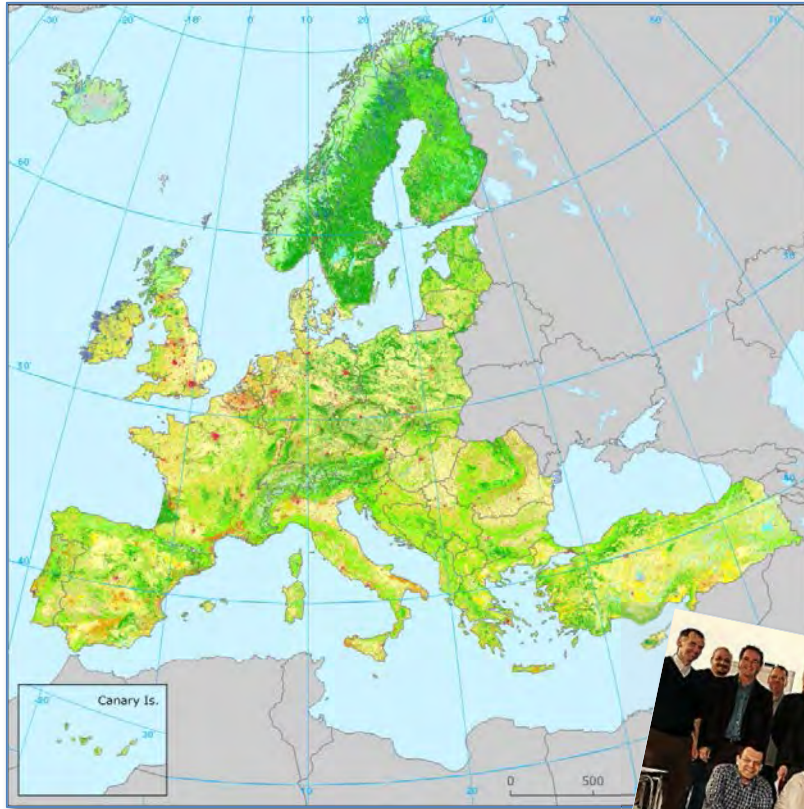
Waterlogging



Drought

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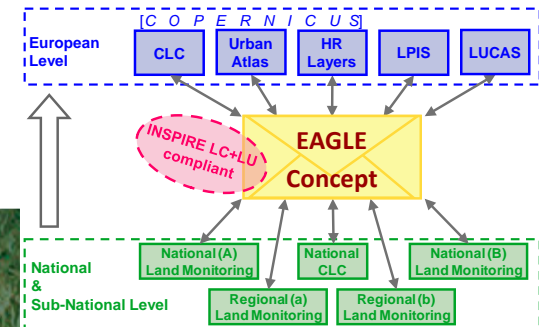
Key role in European land monitoring



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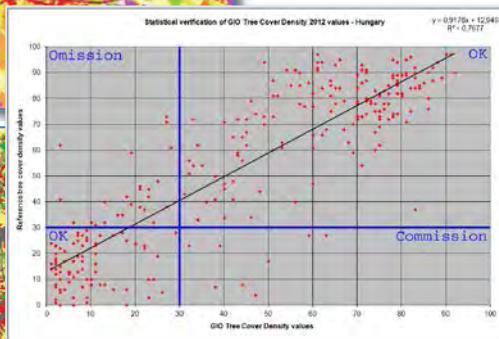
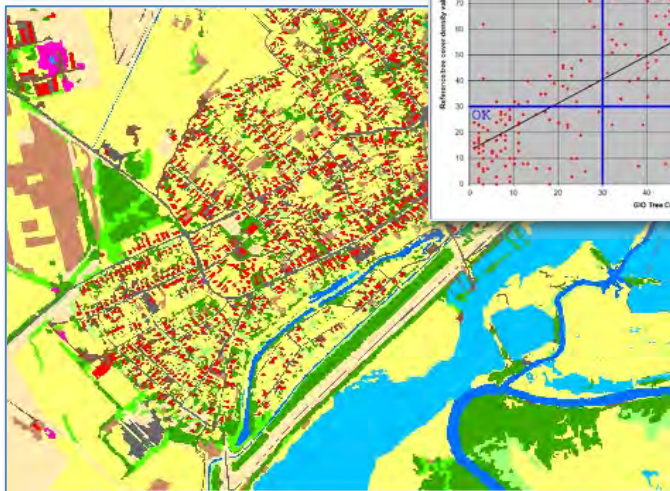
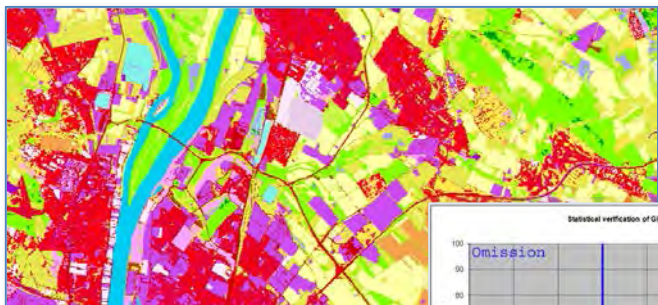
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- Working for **European Environment Agency (EEA)** as member in European Topic Centres since 2001:
 - ✓ 2015- : **European Topic Centre – Urban, Land and Soil systems (ETC-ULS)**
- **Key actor in the coordination of European land cover mapping activities** (CORINE Land Cover a.o.):
Development of **mapping and QA/QC guidelines**, **methodological developments**, **training** of national teams, **HelpDesk** for European countries
- Participation in the **development and testing of LC/LU related environmental indicators** (land take, imperviousness & change)
- Participation in the development of a **European land monitoring strategy** (**EAGLE** working group, **FP7 HELM** project)





National reference institution of land cover mapping



- **National Reference Centre land cover:**
 - ✓ **CLC update & change mapping** for Hungary area
 - ✓ **QA/QC** of various European land cover products
- Strong background in **visual photo-interpretation:**
 - ✓ Designing a **national 1:50.000 scale CORINE Land Cover map (CLC50)**
 - ✓ **Development of a specific tool for visual photo-interpretation** (InterChange used by many European countries for CLC mapping)

Key methodological developments:

- ✓ Designing **change mapping method** for CORINE land cover updates – new standard for Europe
- ✓ Testing EAGLE methodology in the practice – **harmonization of LC/LU related information**
- ✓ Exploring **statistical comparability** of land cover products

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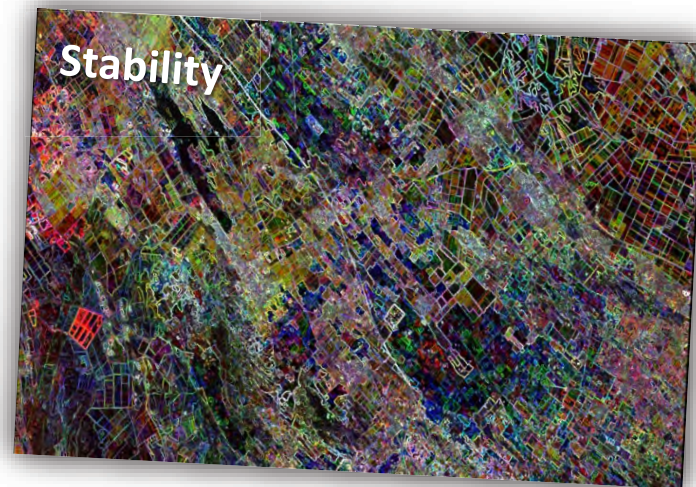
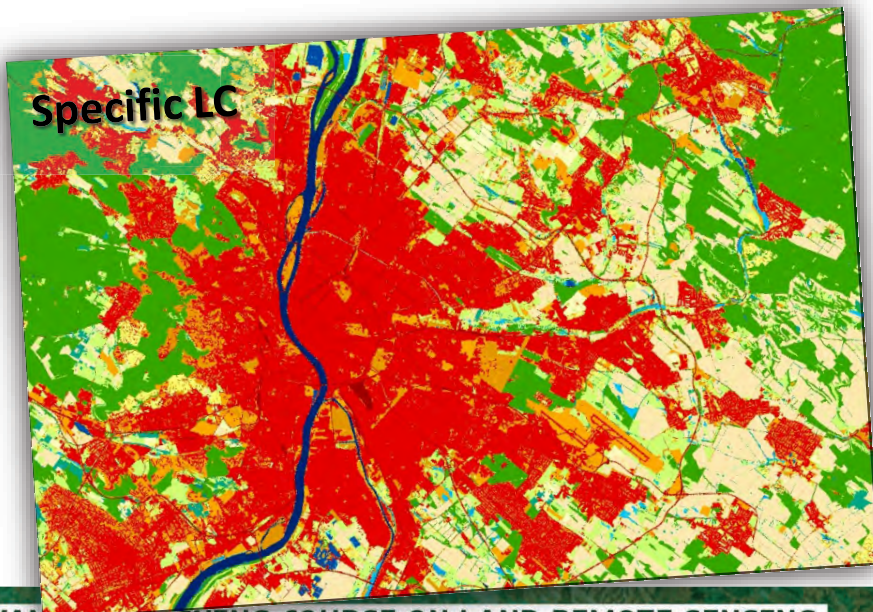
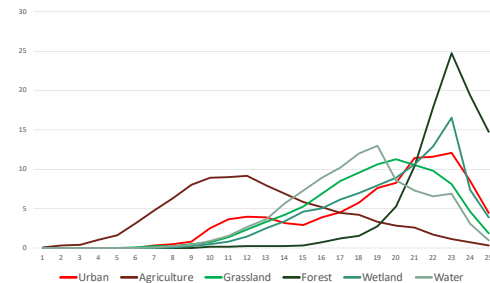


Current operational RS projects at GOCCB-DGRSLA (FÖMI)

Ongoing: Country-wide mapping and status assessment of ecosystem services (NÖSZTÉP)

Led by the Ministry of Agriculture (Nature Protection)

Contribution from various R&D and operational partners

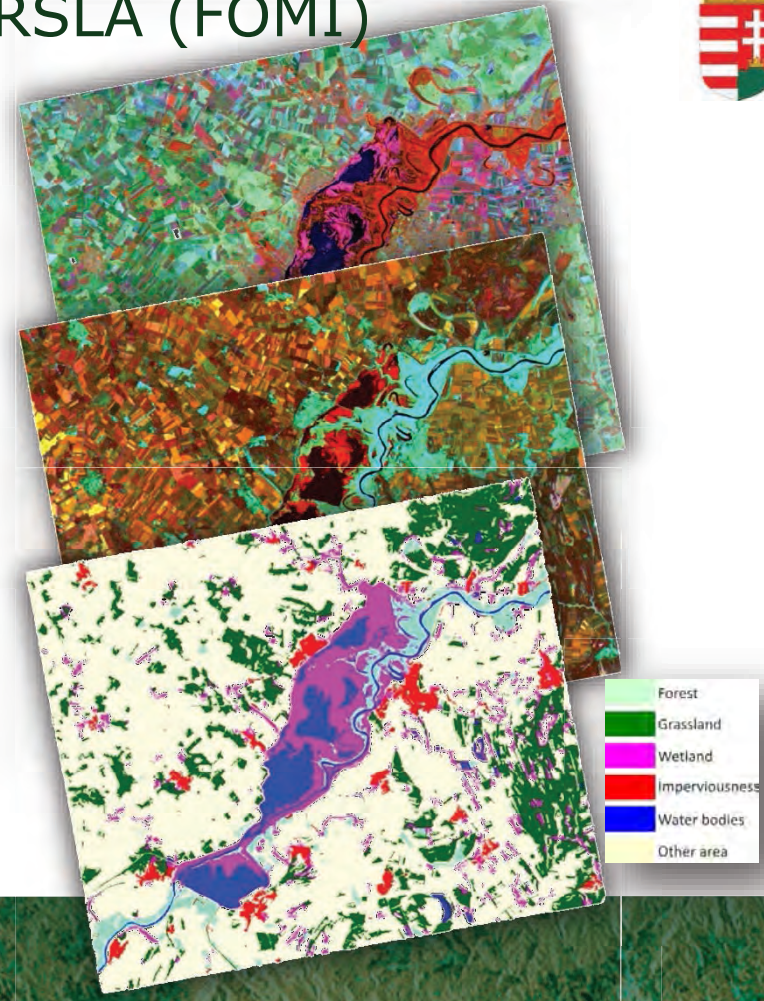
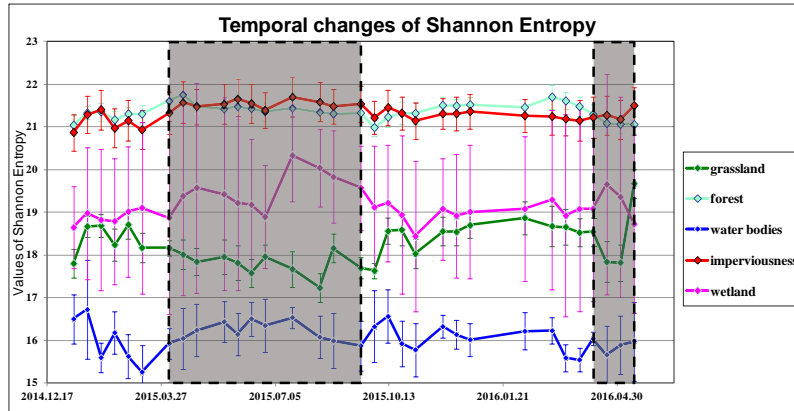


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Competences and R&D - GOCCB-DGRSLA (FÖMI)

- Balanced use of quantitative and visual methods
- Combined use of different data sources
 - RS:
 - airborne/space-borne
 - optical and radar (**fusion**, **polarimetry**)
 - Field surveys
 - Official: LPIS, cadastre, topography
- Processing of big geospatial data (national, EU)



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Eötvös Loránd University, Budapest

Department of Geophysics and Space Science

- Since 1984: more than 90 projects
- Studying the plasmasphere of the Earth by electromagnetic waves
- Investigation of the vegetation based on Landsat/MMS and TM data
- Atmospheric correction of Landsat TM data (ACABA)
- Estimation and forecasting of crop yield using AVHRR and MODIS data
- Monitoring of the vegetation based on AVHRR and MODIS data
- Studying the plasmasphere of the Earth by electromagnetic waves
- Education

Department of Physical Geography

- Environmental reconstruction using UAV photogrammetry
- Flood modeling
- Geostatistical methods in remote sensing
- Heterogeneous forest classification by creating mixed vegetation classes using EO-1 Hyperion

Space Research Group (SRG)

- Satellite receiving station since 2002 (<http://sas2.elte.hu/index-a.html>)
- Automatic processing chain for the DB MODIS data – real time products derived

Faculty of Informatics

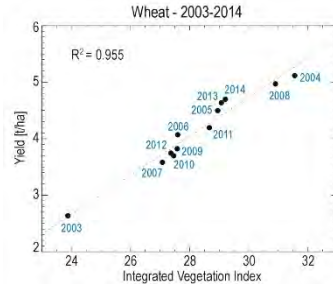
- Development of image processing algorithms and software
- Long-term collaboration in research and education with FOMI: education, traineeship



RS research, Department of Geophysics and Space Science

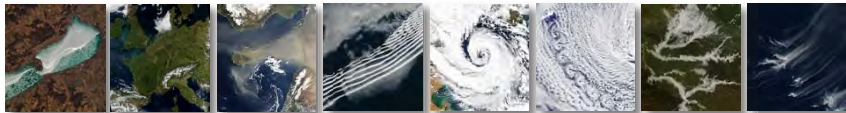
Crop yield estimation based on AVHRR and MODIS data

- From reflectances
- Double Gauss fitting method
- Integrated Vegetation Index
- Robust method



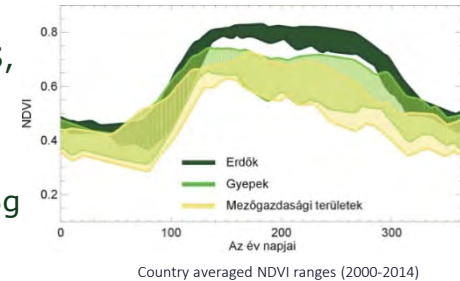
MODIS receiving station – The HRPT

- Since 2002: NOAA HRPT, FY CHRPT
- Since 2004: Direct Broadcast MODIS data
- Data from self-build satellite sensors (onboard Chibis and Relec) measuring electromagnetic waves of the magnetosphere



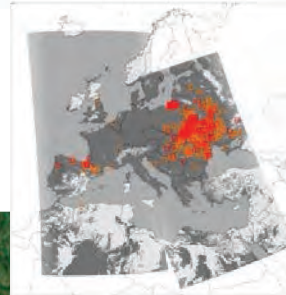
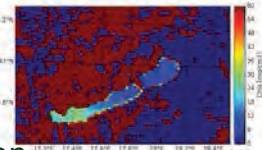
Monitoring Vegetation Activity in the Carpathian-Basin

- Phenological studies (SOS, EOS, etc.)
- Interannual variability
- MODIS and GIMSS NDVI3g data



Derived real-time products:

- Air quality forecasting
- Atmospherically corrected reflectances
- Monitoring the chlorophyll-a in lake Balaton
- Identification of fire and thermal anomalies
- For more check:
<http://nimbus.elte.hu/kutatas/sat/index-en.html>

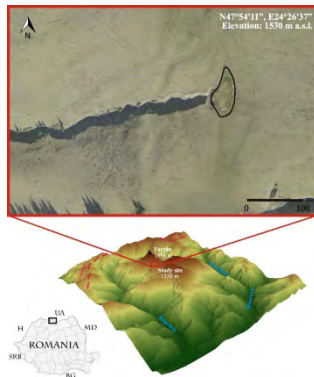
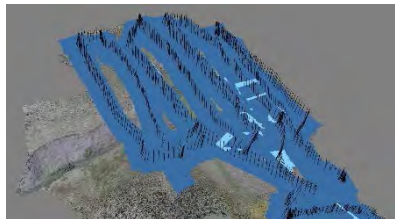


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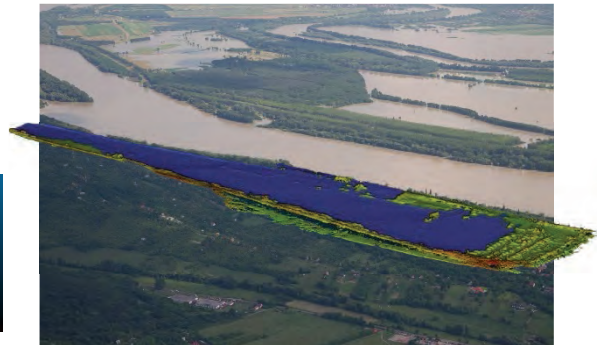
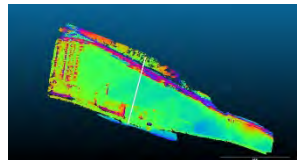
RS research at the Department of Physical Geography

UAV photogrammetry



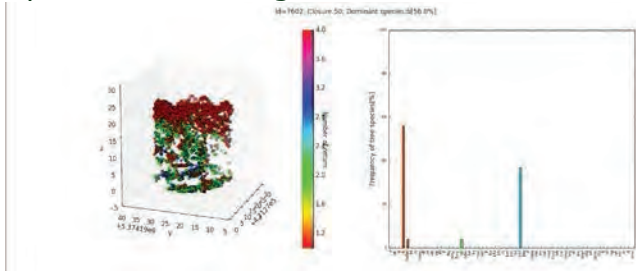
Flood modeling

- UAV
- 3D reconstruction



Geostatistical methods in Remote Sensing

- Combined Cluster and Discriminant Analysis (CCDA)
- Optimization of vegetation classification

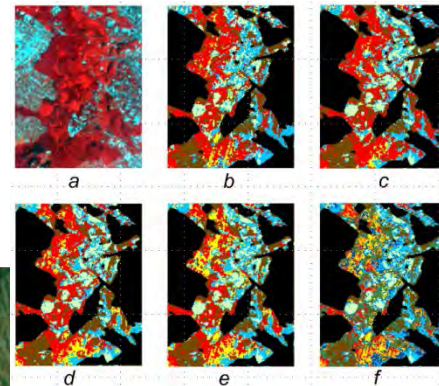


Forest classification using EO-1 Hyperion

- mixed vegetation classification
- influential band analysis: a new band reduction method



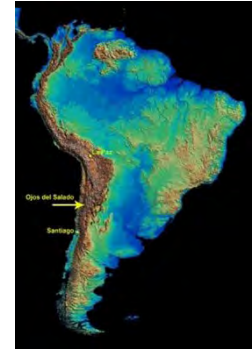
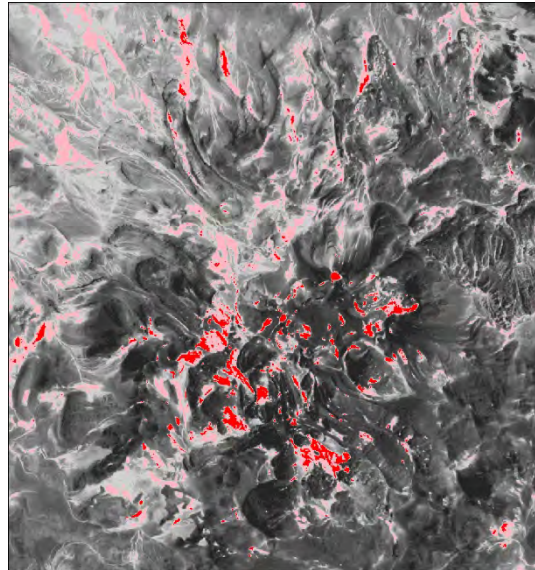
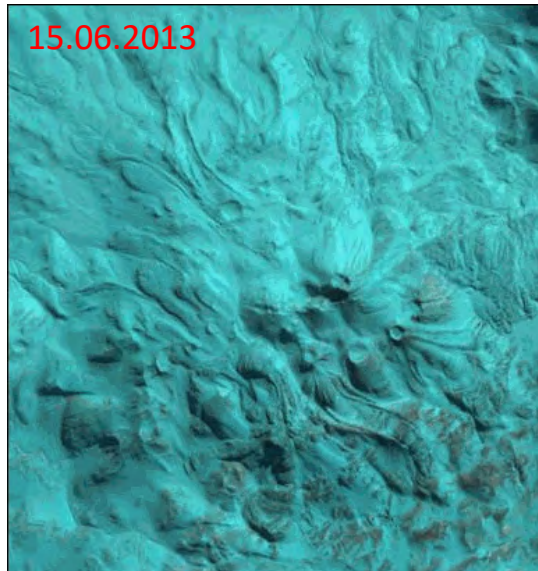
- (a): Image composite
- (b): Full dataset
- (c): PCA reduced data
- (d): SDA reduced data
- (e): 51 influential bands
- (f): 51 bands, mixed classes



RS research at the Department of Physical Geography

Ojos Del Salado, Andes, Chile/ Argentina

- Landsat 7 ETM+ and Landsat 8 OLI (U.S. Geological Survey) from 01.01.2011
- Sentinel 2 MSI images from 08.08.2015 (ESA Copernicus and the U.S. Geological Survey)
- Snow coverage - 3 categories: snow free, partial snow coverage and full snow coverage.



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DEPARTMENT of PHOTOGRAMMTERY and GEOINFORMATICS BUDAPEST UNIVERSITY OF TECHNOLOGY AND ECONOMICS

27 employees:

- 10 lecturers
- 7 phd students
- 5 emeritus lecturer
- 2 administrative and technician

Research fields:

**photogrammetry, remote sensing, GPS,
GIS, digital cartography**



**BUDAPEST UNIVERSITY
OF TECHNOLOGY AND ECONOMICS**

Faculty of Civil Engineering - Since 1782

Department of Photogrammetry and Geoinformatics



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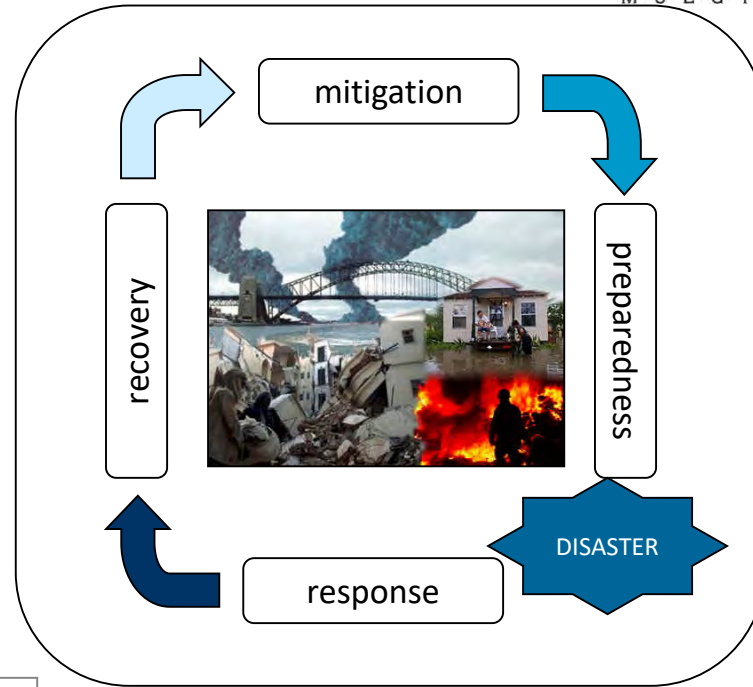
Contact:

**Budapest University Of Technology And Economics
Műgyetem Rkp. 3.
1111 Budapest, Hungary**

**tel: +36 1 463-3086
kugler.zsafia@epito.bme.hu
www.fmt.bme.hu**

Research fields in EO

- Disaster management
 - hazard mapping
 - vulnerability analysis
 - IMPACT assessment
- In cooperation with DLR, JRC, Cambridge University

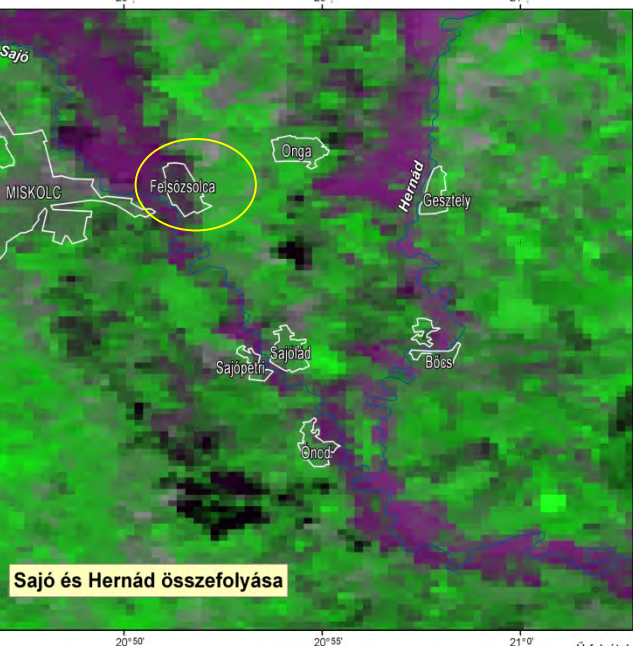
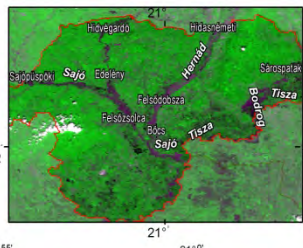


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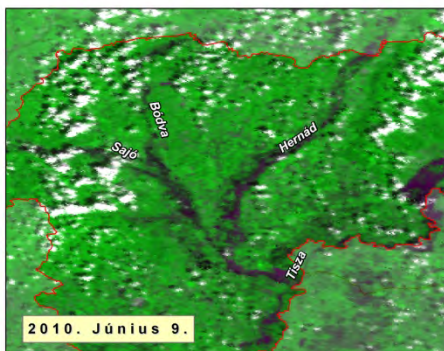
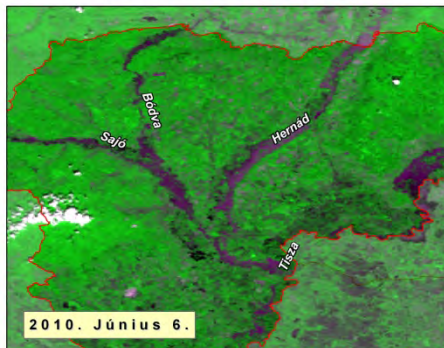
Előtte: 2010 április 26.

Árvízi helyzet: 2010 június 6.



Sajó és Hernád összefolyása

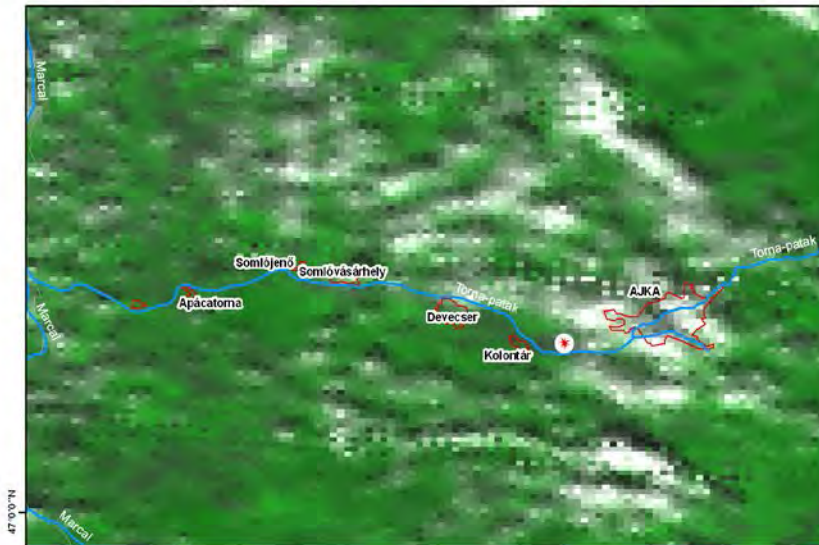
Második árhullám



Ürfelvélet: MODIS
Feldolgozta: Dr. Kugler Zsófia
Budapesti Műszaki és Gazdaságtudományi Egyetem
Fotogrammetria és Térinformatika Tanszék

RED SLUGDE DISASTER ASSESMENT NEAR AJKA/HUNGARY FROM LOW RESOLUTION IMAGERY

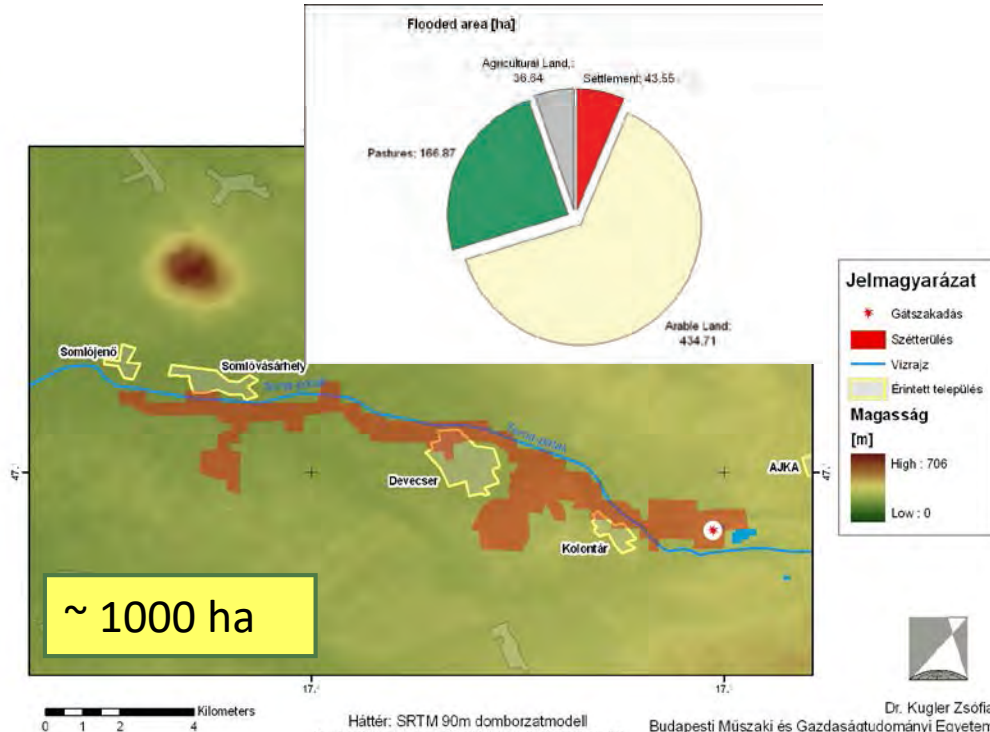
TERRA MODIS IMAGE 07.10.10



0 2.5 5 10 15 20 Kilometers



Background: Budapest University of Technology and Economics
Department of Photogrammetry and Remote Sensing

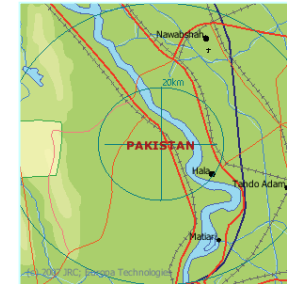
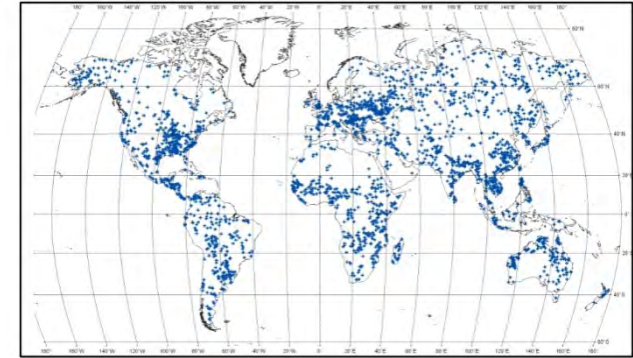
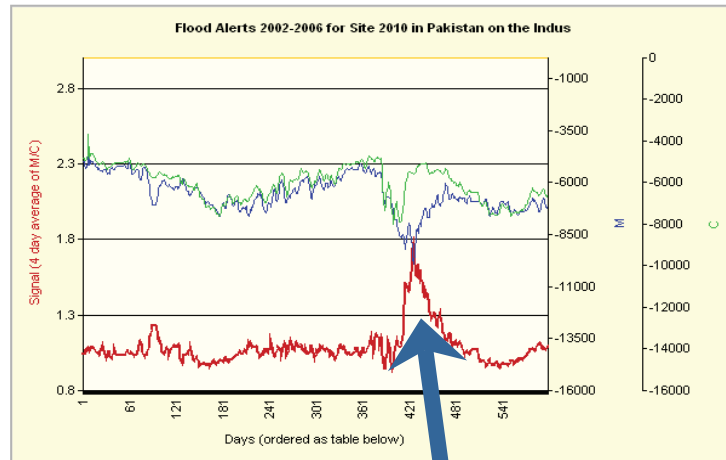


Háttér: SRTM 90m domborzatmodell
Szétterülés: Terra-MODIS ürfelvétel 2010.10.10

Dr. Kugler Zsófia
Budapesti Műszaki és Gazdaságtudományi Egyetem
Fotogrammetria és Térinformatika Tanszék

GLOBAL FLOOD DETECTION SYSTEM (GFDS) AMSR-E PASSIVE MICROWAVE SENSING SATELLITE

- Global **near-real time detection of flow level** (normal flow, flooding, major flood) of selected rivers
- 2633 sites monitored on 1479 rivers
- Daily time series of orbital gauging since 2002 June - present



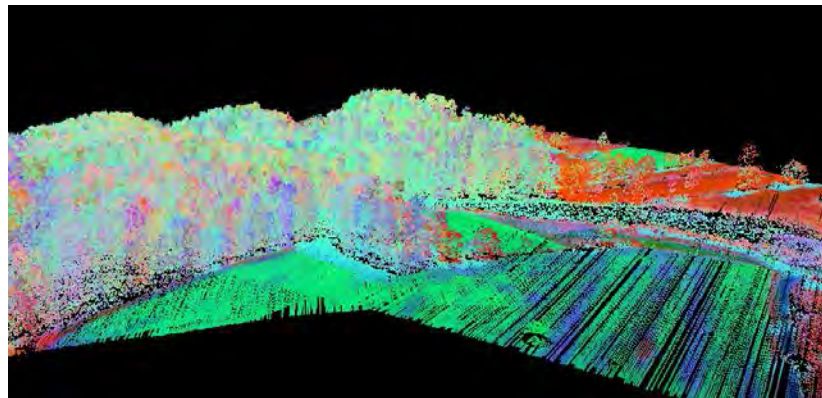
Geographical location

Dartmouth
Flood Observatory

Eszterházy Károly University

Research Institute of Remote Sensing and Rural Development

- The mission of the **EKU RIRSRD** is to conduct basic and ***applied remote sensing research*** for the advancement of scientific knowledge about the environment.
- Our team is responsible for conducting all phases of remote sensing operations, including ***flight/mission planning, sensor maintenance, data acquisition, data processing, data analysis and modelling***
- 10+ years experience:
 - R+D projects
 - Hyperspectral imagery
 - LIDAR and orthophoto
 - Satellite imagery
 - Image processing



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Eszterházy Károly University

Research Institute of Remote Sensing and Rural Development

The institute focuses on the environmental applications of state-of-the-art remote sensing and GIS systems, as well as the development of techniques to enhance the usefulness of these systems. Hyperspectral (HS) applications are of special interest.

An **Aisa FENIX 1K** the top-of-the-range full spectrum (380 – 2500 nm spectral range) sensor with 1024 spatial pixels used for airborne collection operations. This sensor is capable to record more than 600 bands up to 0.5 m ground resolution



Leica ALS-70 HP sensor with high accuracy GPS/INS and **Leica RCD 30 RGBN 60 MP** digital medium format camera



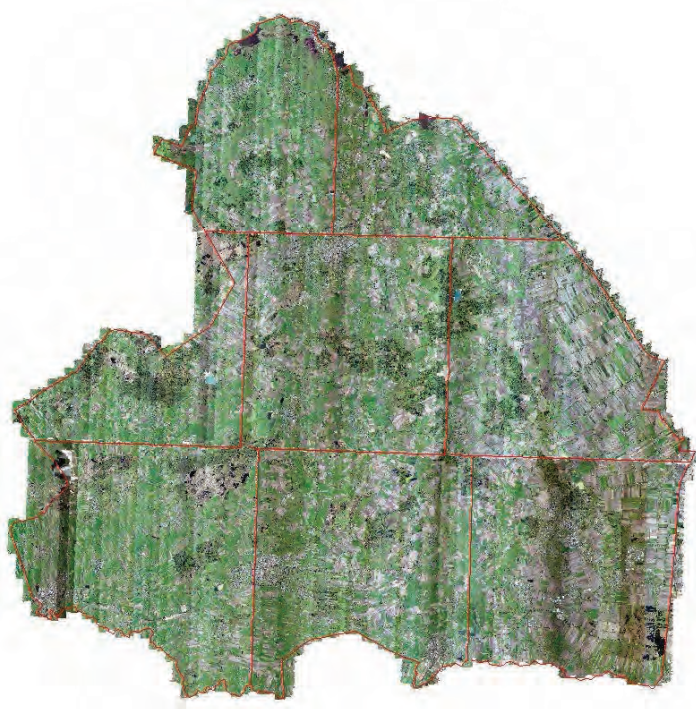
SGI UV 2000 supercomputer and **SGI Octane III** high-performance graphics workstations



Eszterházy Károly University

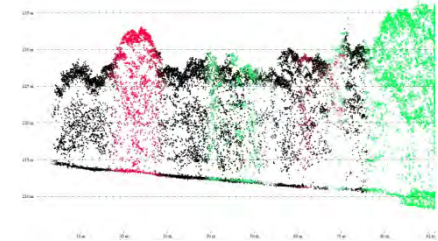
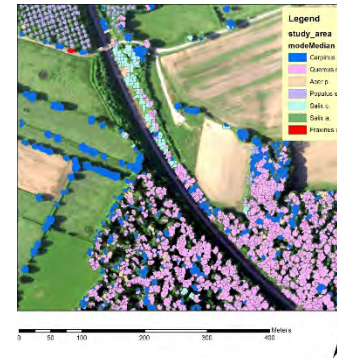
Research Institute of Remote Sensing and Rural Development

Airborne acquisition of large areas

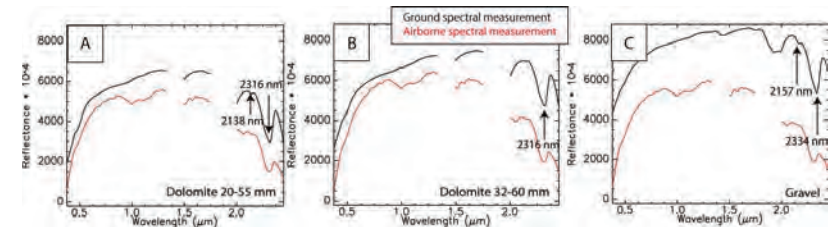


Drenthe province of the Netherlands, AOI area: 2698,15 km²

Developments in image- and point cloud processing



Vegetation and forest mapping

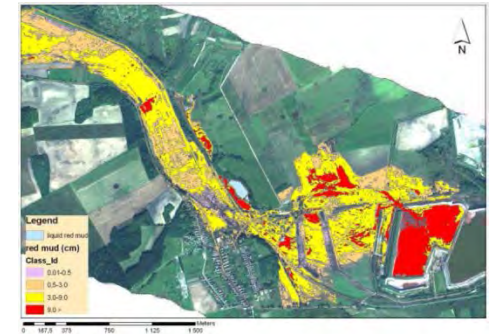


Spectroscopy

United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN SPIDER RSO) office in Hungary - 12th office in the World.
Institutional support of the disaster and emergency response program of the United Nations SPIDER. UN-SPIDER is being implemented as an open network of providers of space-based solutions to support disaster management activities.



MULTI-SENSOR INTEGRATION FOR THE DETECTION AND REMEDIATION OF THE RED MUD SPILL IN KOLONTAR, HUNGARY: ESTIMATING THE THICKNESS OF THE SPILL LAYER USING HYPERSPECTRAL IMAGING AND LIDAR



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Satellite Remote Sensing at University of Szeged, Department of Physical Geography and Geoinformatics

Since 1995:

- Education
- Multidisciplinary research
- Projects

Applications:

- Drought
- Inland Excess Water
- Flood
- Vegetation monitoring
- Urban environment

Researcher staff:

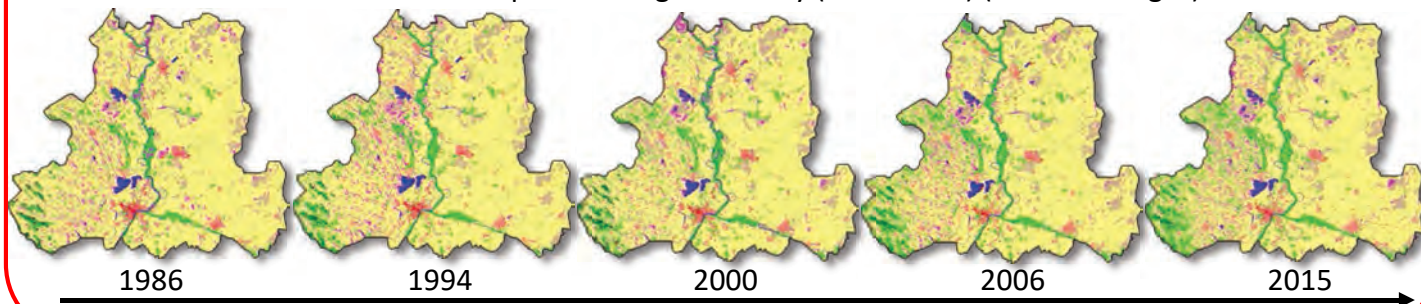
- Henits László
 - Kovács Ferenc
 - Ladányi Zsuzsanna
 - Mucsi László
 - Szatmári József
 - Tobak Zalán
 - Van Leeuwen Boudewijn
- + other colleagues, PhD and MSc students



URBAN – Land cover & Land use

COUNTY LEVEL

Land cover maps for Csongrád county (1986-2015) (Landsat images)

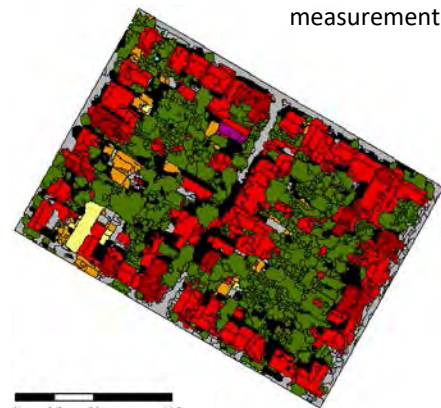


DISTRICT LEVEL

Hyperspectral image + DSM



Hyperspectral image + Laboratory measurement



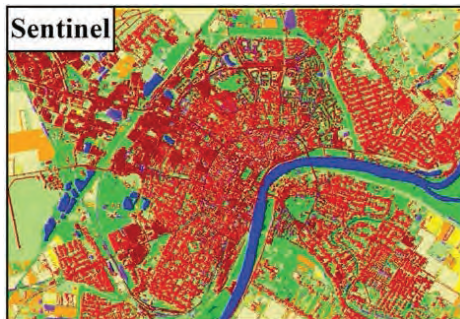
Landsat images



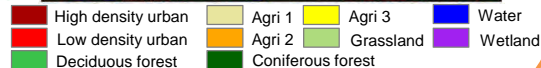
CITY LEVEL (SZEGED)



Sentinel-2 images



Fraction images showing the ratio of impervious surfaces



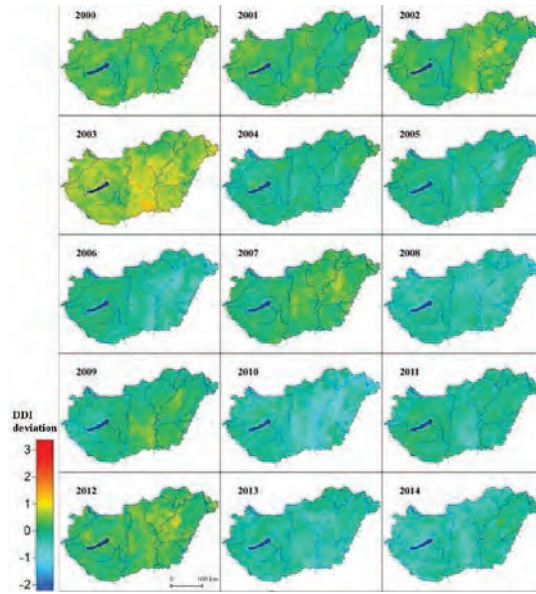
VEGETATION

Data:

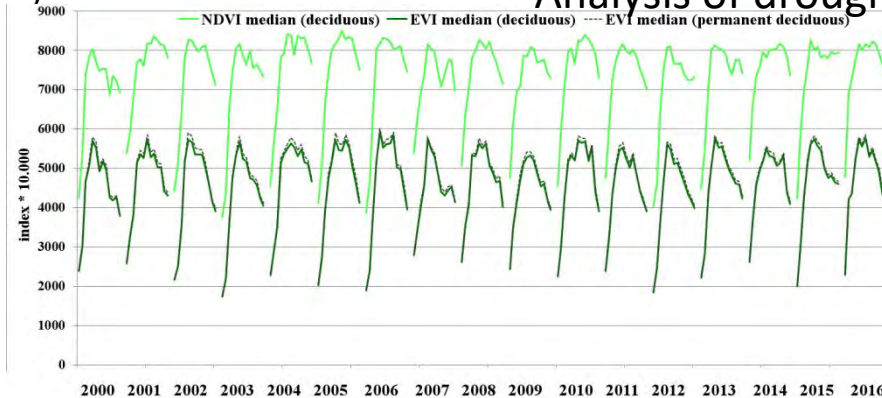
- MODIS products (MOD13Q1, MOD13A1, MOD09A1)
- LANDSAT OLI

Methods:

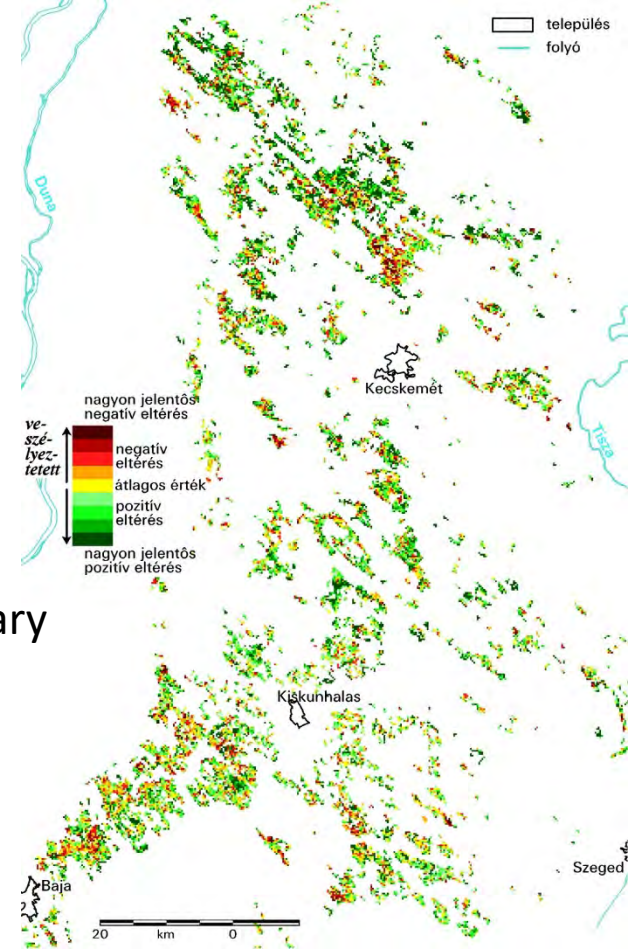
- Multispectral indices
Vegetation, Water
and Drought Indices
(NDVI, EVI, DDI, NDDI,
NDWI)



Analysis of drought in Hungary



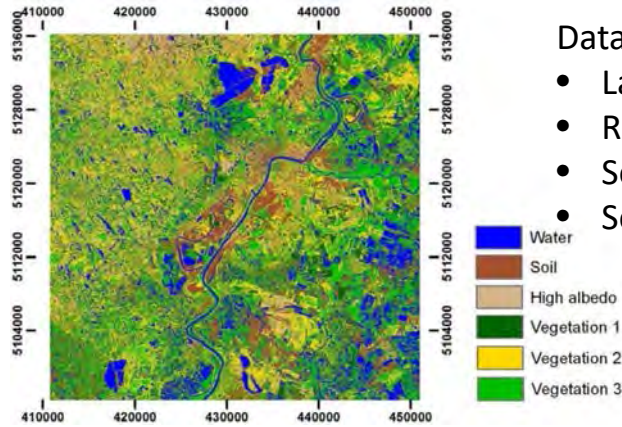
Vegetation changes: forests in Danube-Tisza Interfluve



Climatic sensitivity of forests
in Danube-Tisza Intefluve (on the basis of EVI)

WATER

- Inland Excess Water
- River ice coverage

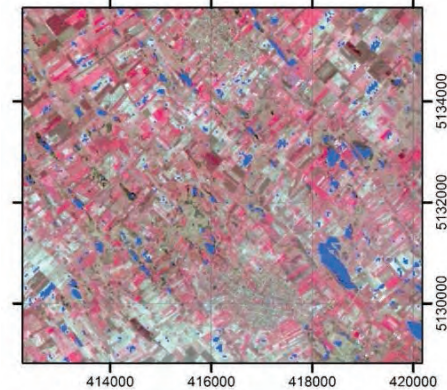
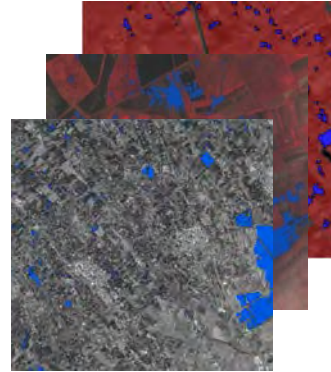
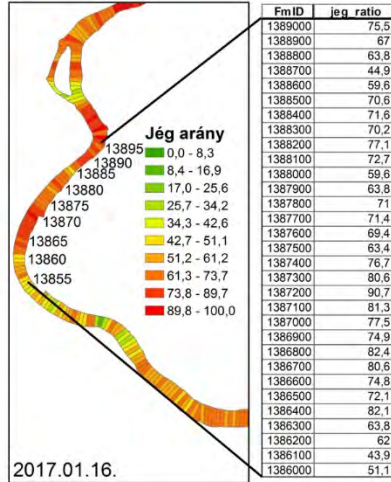
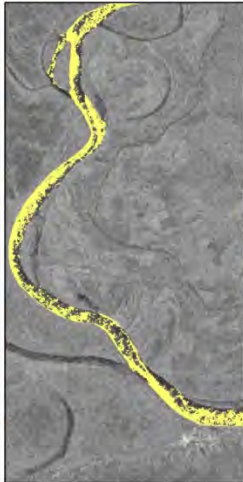


Data:

- Landsat
- RapidEye
- Sentinel 1
- Sentinel 2

Methods:

- Multispectral classification (Isodata, ML, SAM, SMA)
- Multispectral indices
- Artificial Neural Networks
- Spectral slicing



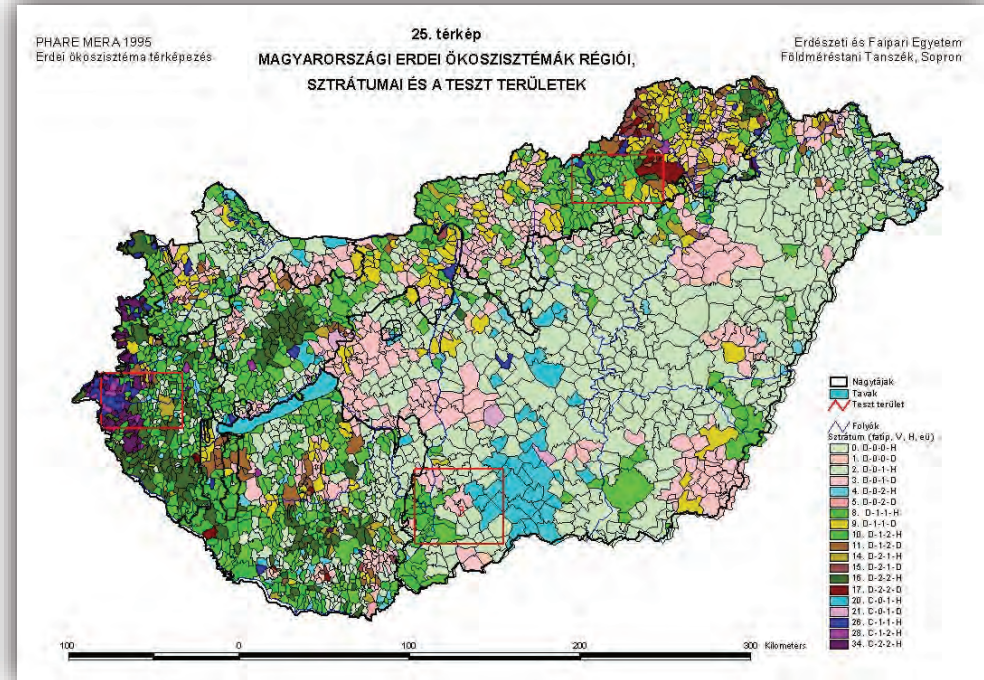
Belváz
Állandó víz

University of Sopron



Faculty of Forestry, Dept. Of Surveying and Remote Sensing

- Forest ecosystem mapping
- Participation in the development of TopoLynx / DigiTerra software (GIS and image processing)
- Development of new image classification methods
- Object-based image analysis / eCognition trainings
- Participation in the preparation of the Hungarian Earth Observation Information System (FIR) – Forestry module



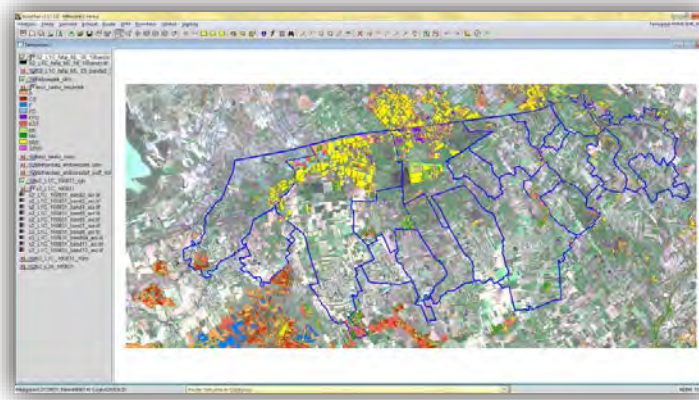
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University of Sopron

Improve temporal and spatial resolution of forest inventory with Sentinel-2 products using highly automated methods

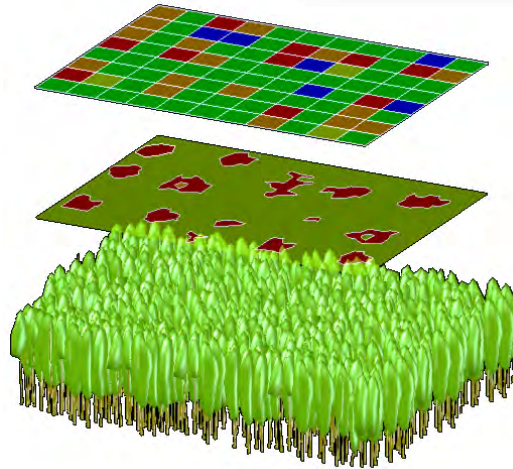


Forest cover on sub-pixel level from 10 m bands

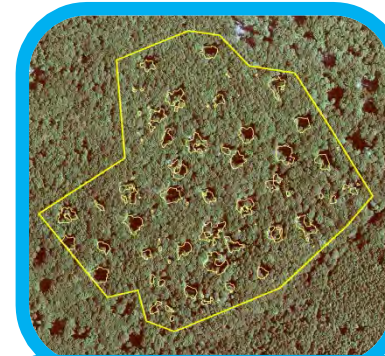
Multiple times a year

VHR reference layer from field and aerial survey

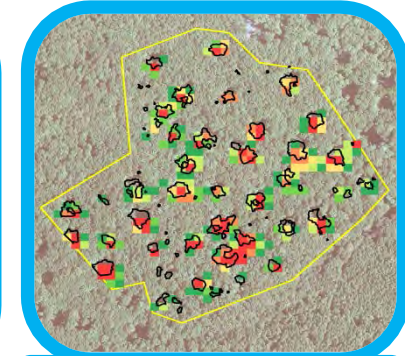
5-10 years



Treefall gap mapping with Sentinel-2A images



Orthophoto from 2015



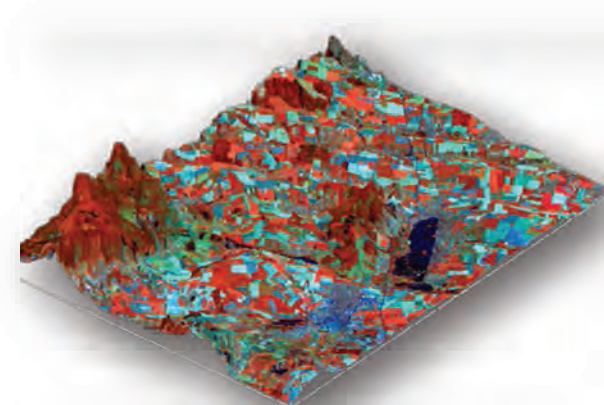
Treefall gaps in 2016

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Alba Regia Technical Faculty, Székesfehérvár:

- Remote sensing in agriculture
- Research related to soil quality protection
- Land cover and land use mapping, change detection
- Accuracy and application opportunities of digital elevation models
- Remote Sensing of Urban Ecology
- Development of classification methods
- Hungarian-Chinese Intergovernmentals Cooperation Programme (TÉT)
- WAREMA (LC, LU)
- Education

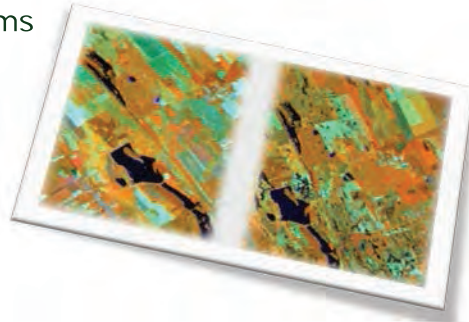


RS research at the Alba Regia Technical Faculty



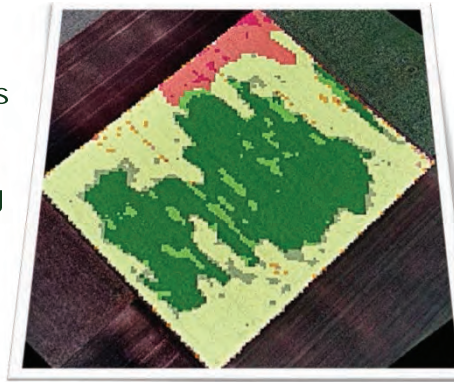
Remote Sensing applications in agriculture

- Agri-environmental problems
- Soil erosion
- Extreme water balance situations
- Precision agriculture



Precision agriculture

- Effects of irrigation systems
- Vegetation monitoring
- Management zone mapping

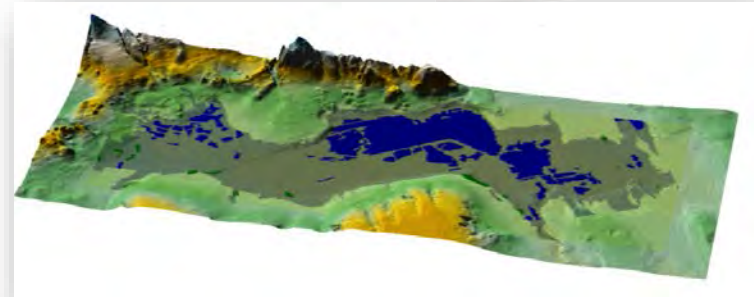


Protection of soil quality

- Land cover/land use mapping
- Soil erosion, and phosphorous load observation on agricultural land
- Soil erosion assessment



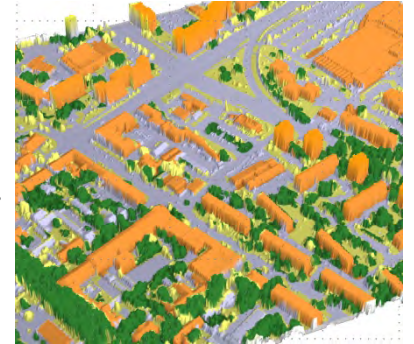
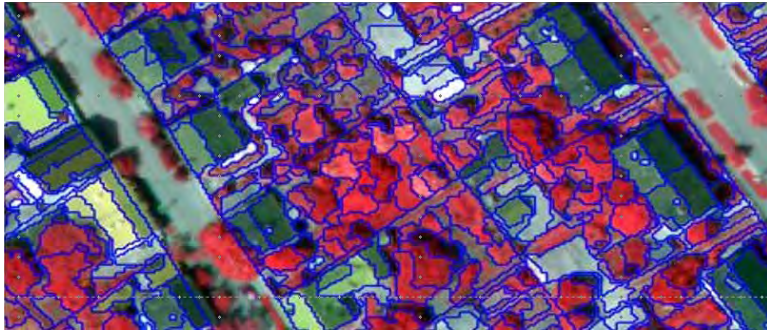
Mapping land cover and its long-term changes



RS research at the Alba Regia Technical Faculty

Remote Sensing in Urban Ecology

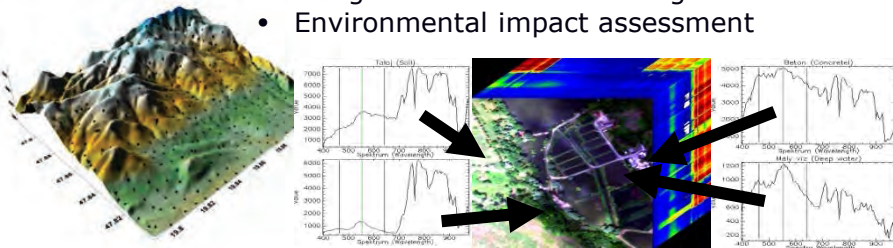
- Land cover mapping
- Building extraction (LIDAR)
- Mapping impervious surfaces within parcels
- Use of high spatial resolution imagery and GIS techniques
- Investigating urban sprawl through integrating remote sensing and other thematic maps



University of Debrecen

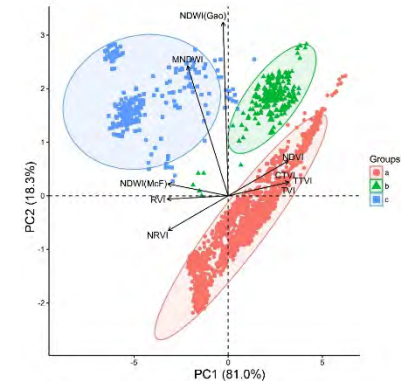
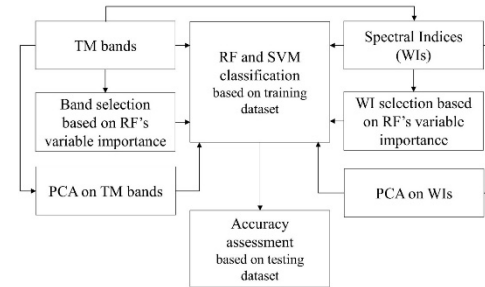
Institute of Water and Environmental Management:

- RS staff: 7
- RS as obligatory subject from 1997
- Main topics:
 - Applied GIS-GNSS
 - DEM
 - Remote sensing
 - Hyperspectral Image Spectroscopy
 - LIDAR
 - MobilGIS- Near field RS
- Projects
 - Soil remediation
 - Precision agriculture
 - Integrated watershed management
 - Environmental impact assessment



Department of Physical Geography and Geoinformatics:

- Land Use / Land Cover classification, modeling and dynamics
- Landscape metrics
- Extraction of water-related features

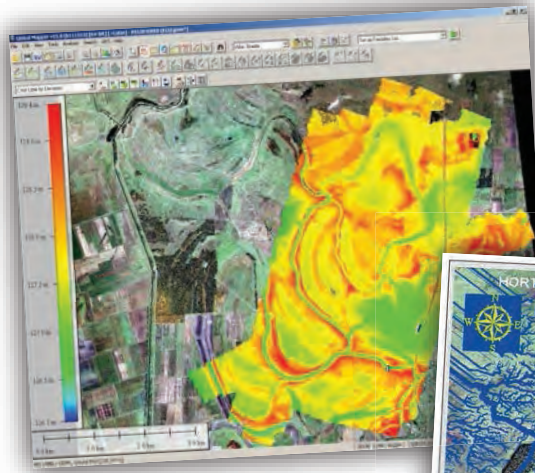


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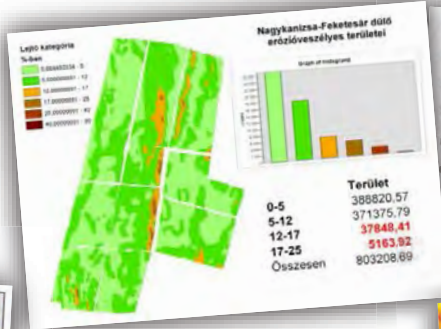
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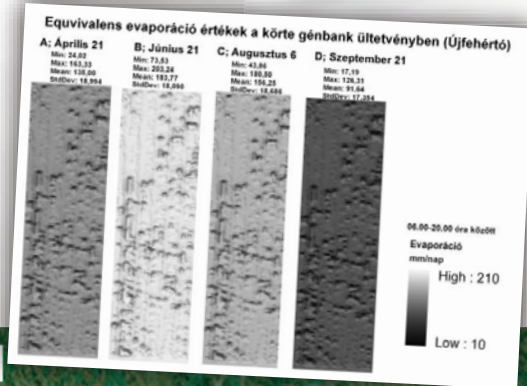
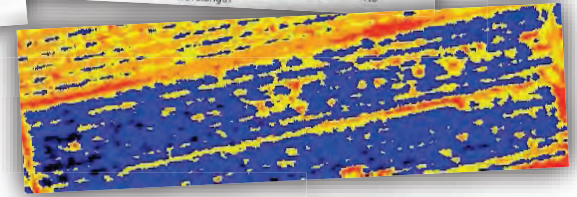
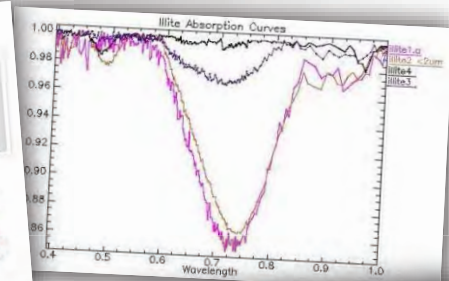
Institute of Water and Environmental Management



LIDAR-based runoff modeling in an extremely flat area



Soil Maps

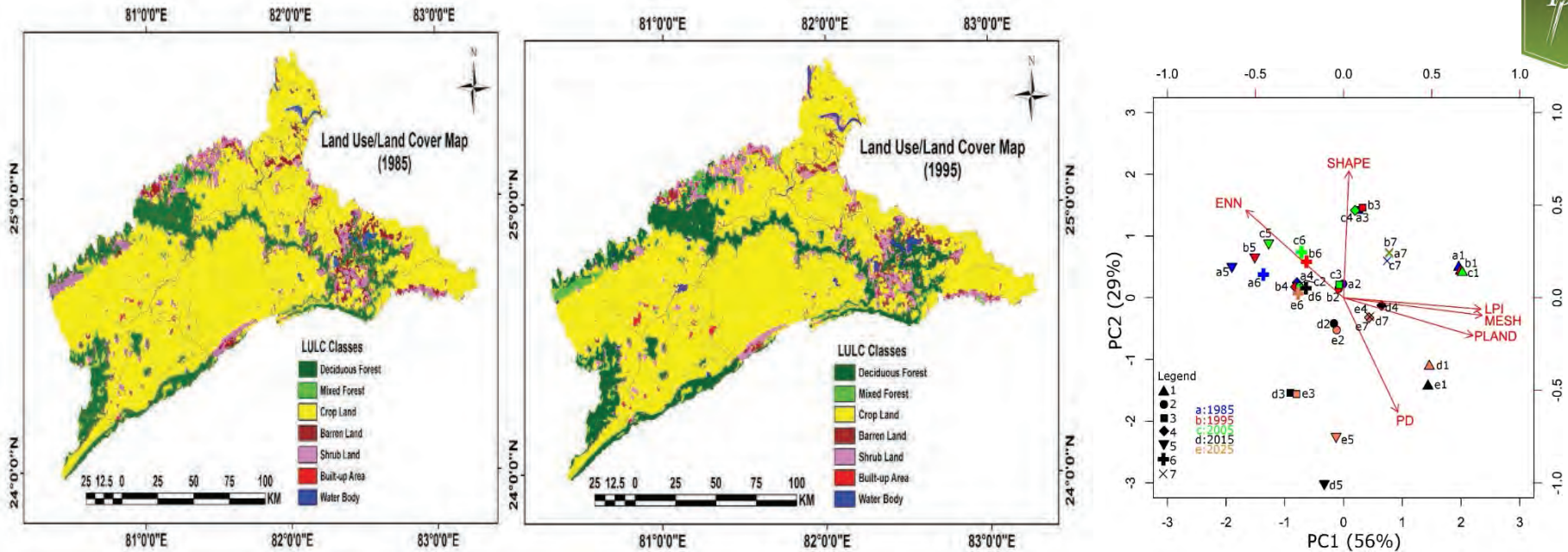


Biophysical parameters (evapotranspiration)

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Department of Physical Geography and Geoinformatics



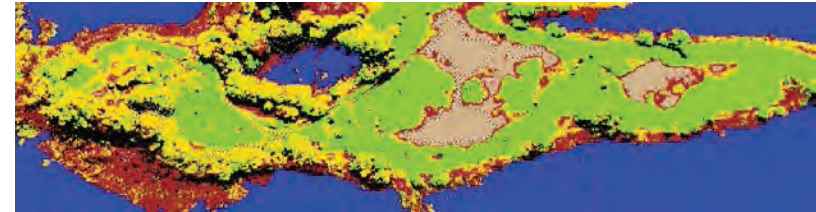
Landscape fragmentation in time series using Landsat imagery and landscape metrics

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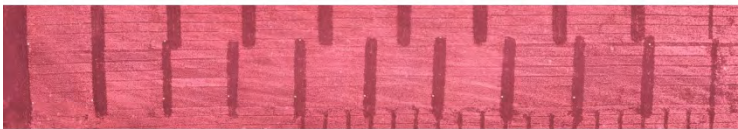
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Dennis Gabor College

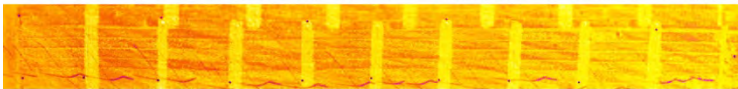
- Development of image processing algorithms
- Mapping invasive plants
(in cooperation with the University of Pannonia)
- Multispectral detection of plant stress
- Disaster management
(red mud RS team lead - see later)



VIS



NIR



FIR



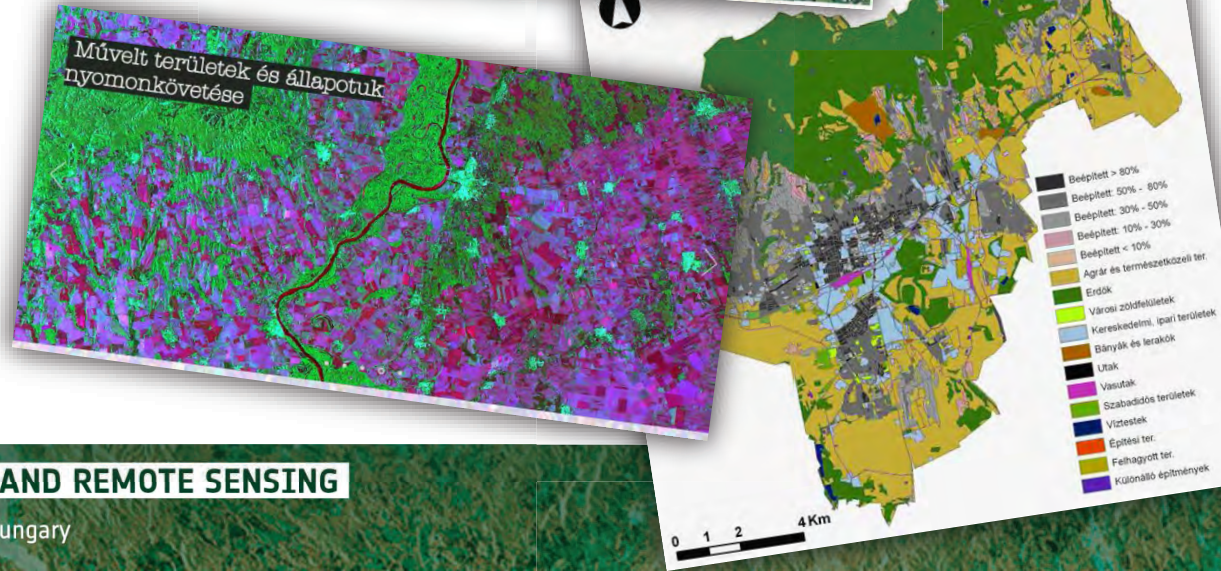
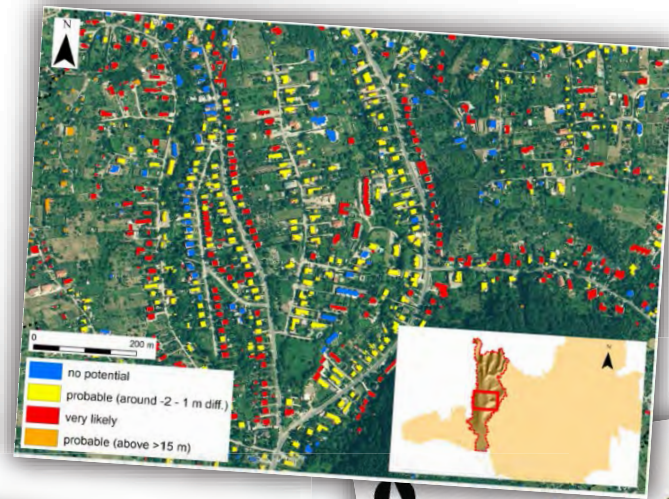
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University of Pécs



- Institute of Geography
 - Environmental change
 - Water management
 - Image processing
 - Object-based Image Analysis
 - Urban applications
 - GIS
- SAR processing / Sentinel-1
 - Agricultural applications
 - Surface deformations
 - Inland excess water
 - Disaster management
 - Supercomputer
 - International cooperation



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Faculty of Agricultural and Environmental Sciences

- **Institute of Botany and Ecophysiology:** Measurement and modelling of evapotranspiration and green house gas fluxes in vegetation by proximal and remote sensing
- **Institute of Environmental Science:** RS applied to water resources
- **Institute of Nature Conservation and Landscape Ecology:** Environmental monitoring, Land use analysis, Landscape metrics, GIS

Faculty of Landscape Architecture

- **Dept. of Landscape Planning and Regional Development:** Land cover / land use, Landscape metrics, GIS

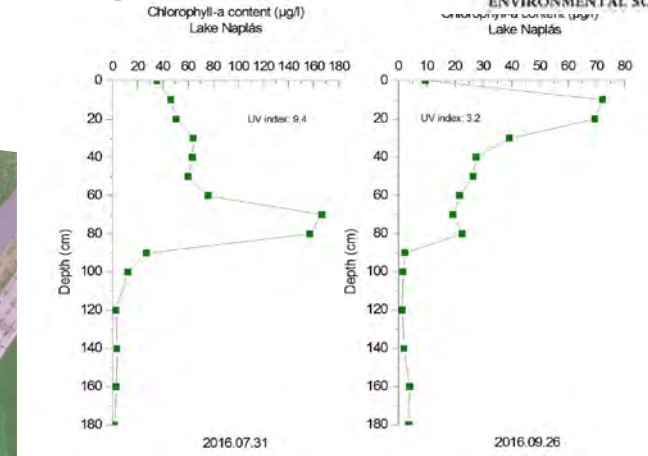
Faculty of Horticultural Sciences

- **Technical Department:** Precision horticulture, Agricultural geoinformatics, Imaging and field spectroscopy, High-resolution sensing

PhD work at SZIU (Mr. János Grósz)

Objective:

- Define vertical distribution of algae concentrations in lakes and its influencing factors.
- Build database on field measurement results and develop a model
- Define the effect of the vertical distribution on the irradiance reflectance and its angular distribution
- Develop satellite-based monitoring methods



Algae bloom in Lake Naplás

TIGER project: SZIU and Univ. of Rwanda

Application of Remote Sensing Data to Improve the Water Resource Management of Rwanda



Objectives

Use of Sentinel 1 and 2 data and on the application of the Water Observation Information System (WOIS) software package for:

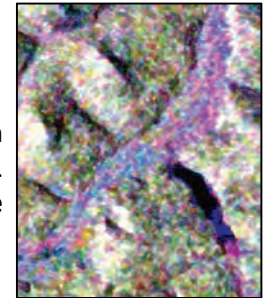
1. The monitoring of water level fluctuation in reservoirs to estimate the volume.
2. To develop a methodology for monitoring wetlands, and the phenology of rice.
3. To develop soil property maps for the estimation of suitability of soils for irrigation.



Ricefield on
Sentinel 2
image



Ricefield on
Sentinel 1
image



Nile Ecosystems Valuation for Wise Use

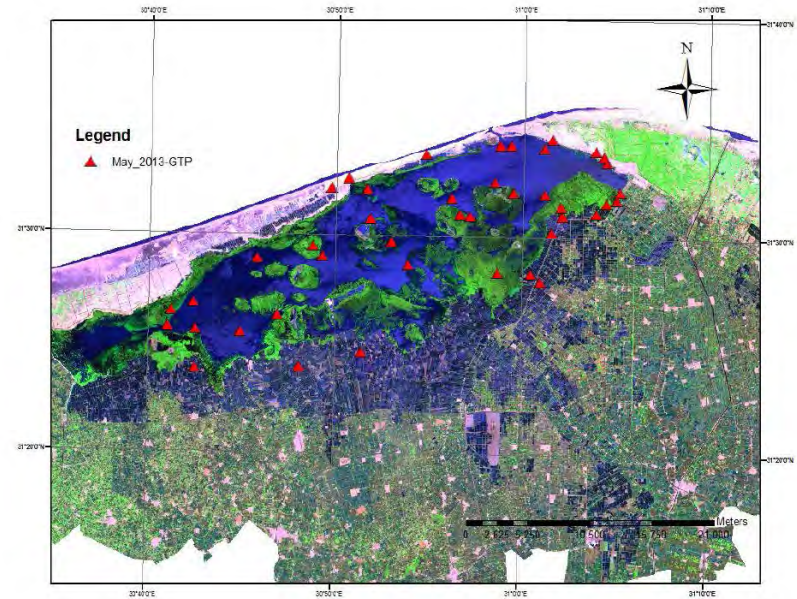
Project for CGIAR Research Programme on Water, Land and Ecosystems

Tasks of SZIU:

- Capacity building on EO methods for wetland monitoring
- Supervision of fieldwork planning and EO work



Figure 25 Wetland before breaking off (2010) and after breaking away from the main wetland (2015)



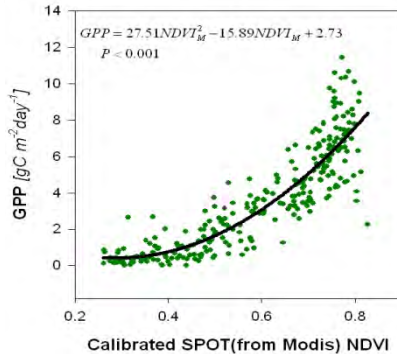
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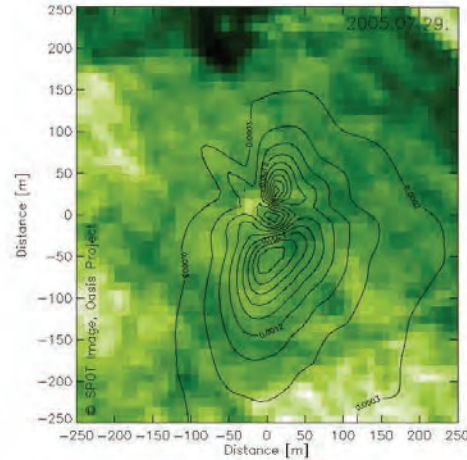
Institute of Botany and Ecophysiology



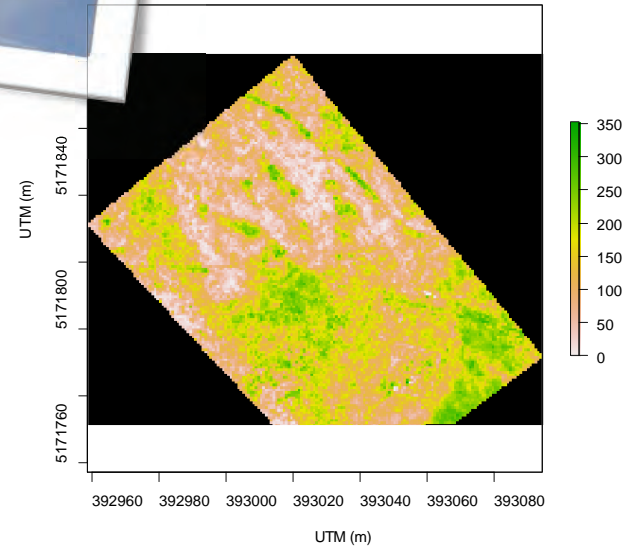
Eddy covariance, grassland site,
Bugac, Hungary (HU-BUG)
Time series since 2002



Eddy flux footprint
overlayed on SPOT NDVI



Biomass amount (g/m²)



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Campus Budapest, Technical Department

Remote Sensing Working Group since 2016

Head: András Jung (Copernicus relay)

Research areas:

-Agricultural Remote Sensing

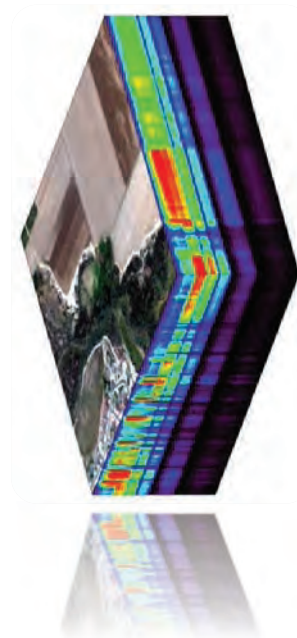
- Viticulture and Fruit Growing (1 PhD student)
- Sentinel Land Monitoring (1 PhD Student)

-Hyperspectral Snapshot Imaging

- UAV based and mobile mapping (1 post-doc)

-Proximal Sensing & Field Spectroscopy

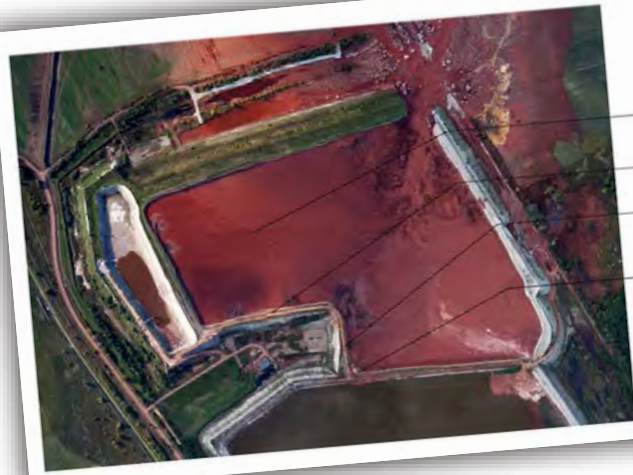
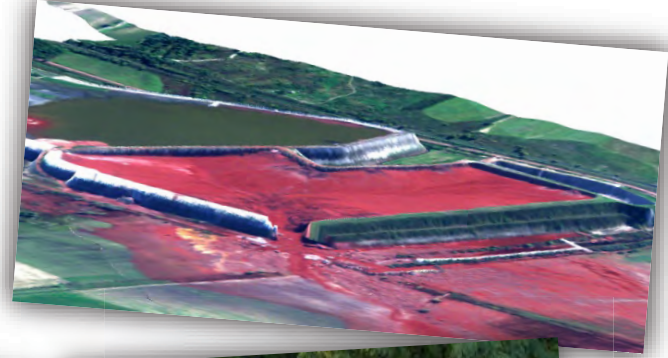
- Soil and vegetation spectroscopy (1 PhD Student)
- Laser scanning and canopy modelling (1 post-doc)



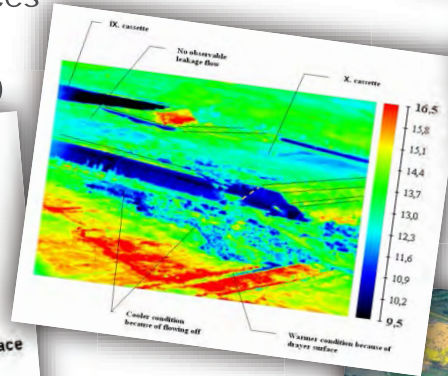
Cooperation: example

Red mud sludge disaster – Ajka/Kolontár, 4 October 2010

- Deaths: 10, Injured: >150, Evacuated: 390
- RS assessment with the cooperation of numerous Hungarian groups
- Scientific lead: Hungarian Academy of Sciences
- Coordination: National Directorate for Water
- Financed by Karoly Robert College (now EKE)



Recessing
Dam
Torn dam surface
Input tube



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WRAP-UP, CONCLUSIONS AND OUTLOOK

Remote Sensing community and penetration in Hungary



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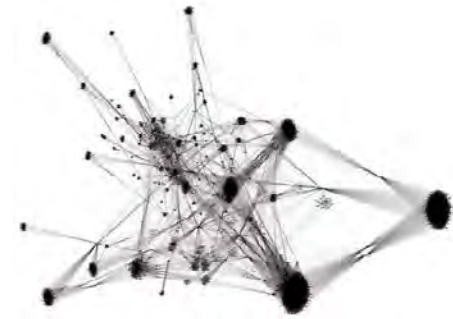
Remote Sensing community and penetration in Hungary

- Government: GOCCB/DGRSLO (formerly: FÖMI) mandated as central RS organization
- Operational application in numerous sectors: agriculture, environment, water, nature protection, disaster management
- RS in higher education, R&D
 - courses and research groups at most major universities
 - linked to different disciplines (geography, engineering, GIS, agriculture, forestry, environment, water management)



Remote Sensing community and penetration in Hungary

- Companies
 - GeoIQ: organiser of annual RS conferences
 - Airbus DS Hungary
 - Eurosense
 - EnviroSense
 - GeoAdat
 - Flexiton
 - ...
- NGOs
 - MFTTT: Hungarian Society for Geodesy, Cartography and Remote Sensing
 - HUNAGI
 - Hungarian Astronautical Society



Conclusions and recommendations

- Remote sensing / Earth observation has **important traditions** in Hungary
- A **diverse RS ecosystem** exists, with **specialized knowledge** present at different institutions
- **ESA membership** and the **Copernicus** programme provide unprecedented possibilities to exploit this potential
- Good examples for cooperation, but **more efficient coordination** and **national strategy** would catalyse the process
- **Parallel developments** (national/EU/ESA) to be **avoided**, **existing solutions** to be **involved**
- Example - NASA/USGS: numerous RS research groups and companies involved in the process reaching from R&D to operational tasks and services



Thank you!

Directly contributed to this presentation:

FÖMI /BFKH:

Péter Winkler
György Büttner
György Surek
Gábor Mikus
Gergely Maucha
István László
Márta Belényesi
Angéla Olasz

**Eötvös Loránd
University:**

Anikó Kern
Gábor Tímár
Márton Deák
László Mari

**Eszterházy Károly
University:**

Péter Burai

**Budapest University
of Technology and
Economics:**

Árpád Barsi
Zsófia Kugler

University of Szeged:

Boudewijn van Leeuwen

University of Sopron:

Géza Király
Iván Barton

Óbuda University:

Malgorzata Verőné Wojtaszek

University of Debrecen:

János Tamás
Szilárd Szabó

Dennis Gabor College:

József Berke

Szent István University:

Zoltán Nagy
Márta Belényesi
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