

Support of Disaster Management by Land Administration and SDI

Bence TORONYI – Gyula IVÁN – Gábor MIKUS
Institute of Geodesy, Cartography and Remote Sensing (FÖMI), Hungary

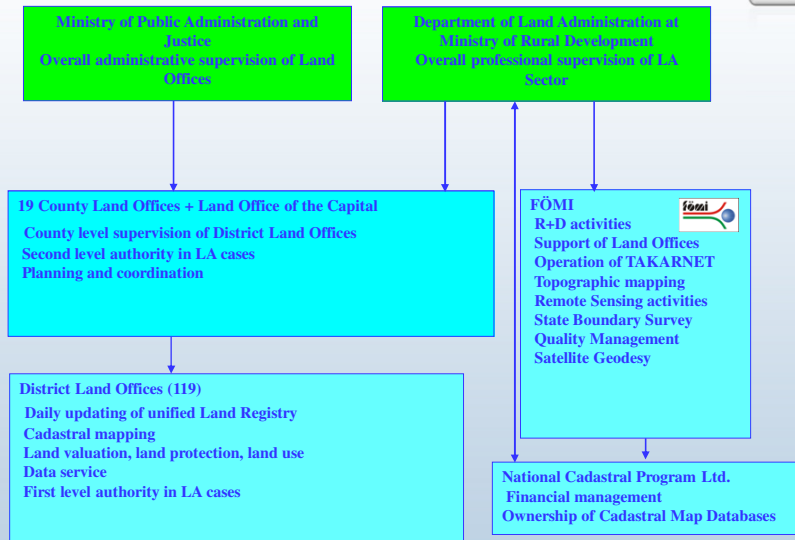
FIG Working Week, 2011.
Bridging the Gap between Cultures
Marrakech, Morocco, 18-22 May, 2011.

Hungary

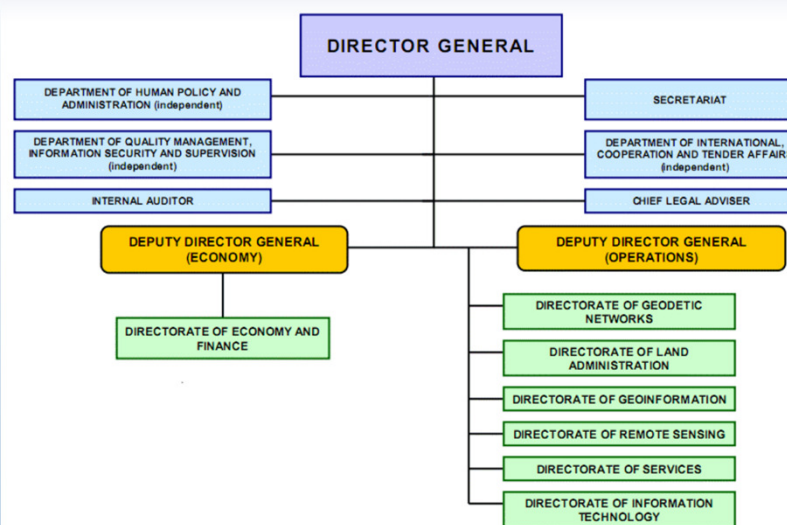


- **Area: 93 000 sqkm**
- **Population: 10 million**
- **Economy: (GDP based)**
 - Services (62%)
 - Industry (27 %)
 - Agriculture (5%)
- **GDP: 9 800 Euro/Capita**
- **Cadastral & Land Registry:**
 - No. Of Parcels: 7,6 million
 - No. Of Properties: 10 million
 - No. Of Transactions via on-line Land Registry Services:
 - 4,2 million (2010)

Hungarian Land Administration



Organization of FÖMI

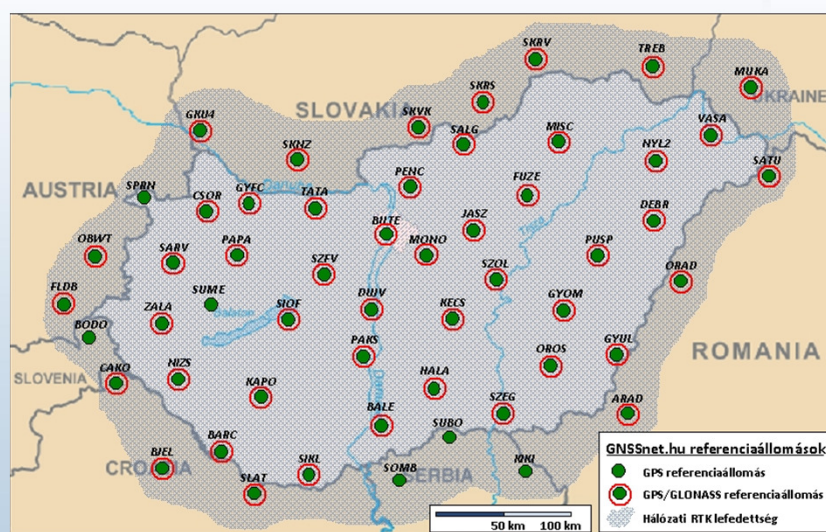


FÖMI's activities in SDI & LA I.



- Providing the basis of positioning
 - Geodetic network (traditional and GPS based)
 - R+D on Space Geodesy (VLBI, Geodynamics, Radar Interferometry)
 - Official GNSS Services
 - State Boundary Survey
 - Large Scale (1:10 000) topographic mapping
- Providing the operation and development of LA IT systems
 - Operating the network of LA (TAKARNET)
 - Land Registry Services via TAKARNET
 - Operating of Central Unified Land Registry Database
 - Continuous development of IT systems
- Providing and development of Remote Sensing Applications
 - Operating and development of Land Parcel Identification System
 - Operating and development of CORINE Land Cover Databases
 - R+D on different Agricultural Remote Sensing Applications
 - R+D on Digital Image Processing

GNSS Infrastructure

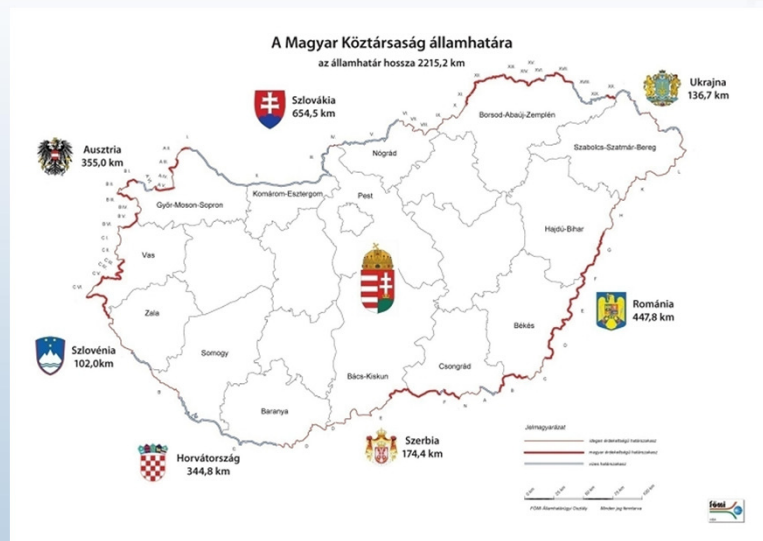


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State Boundary Survey



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Land Registry Services



Üdvözlők: SZILVAY GERGELY Kijelentkezés



ÜGYFÉLSZOLGÁLAT

Telefon: 06 (1) 460-4079, fax: 06 (1) 221-7045
Elérhető: H-Cs: 8:30-16:00, P: 8:30-13:30

Itt nem vagyunk Hiba-bejelentés



Kezdőlap > Szolgáltatások > **Keresési mód választás** > Keresési feltétel megadása > Választás > Fizetés > Dokumentum letöltés

Dokumentum, szolgáltatás igénylése ingatlan kiválasztásával

- ➔ **Keresés helyrajzi szám alapján**
Ingatlan keresése pontosan ismert helyrajzi szám alapján.
- ➔ **Keresés cím alapján**
Ingatlan keresése teljes, vagy részleges cím alapján.
- ➔ **Térképes kereső**
Ingatlan keresése térképen.

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Land Parcel Identification System

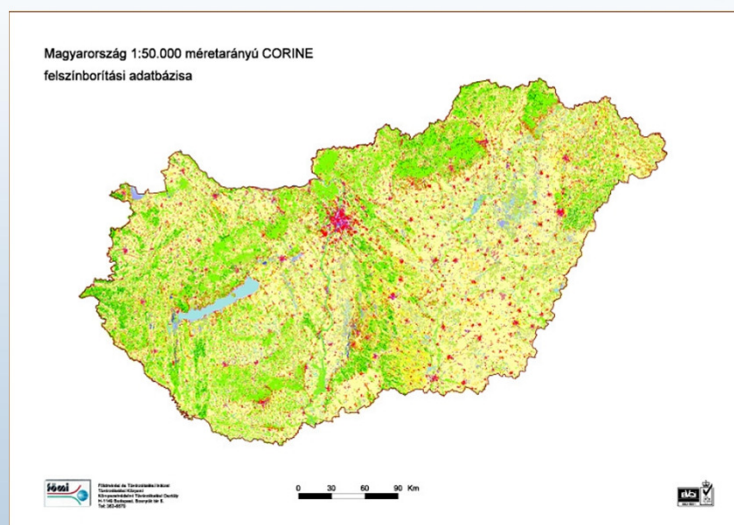


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CORINE Land Cover Database

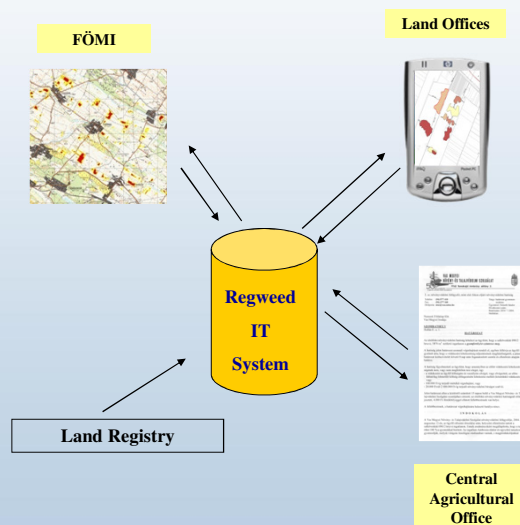


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Regweed Monitoring by Remote Sensing

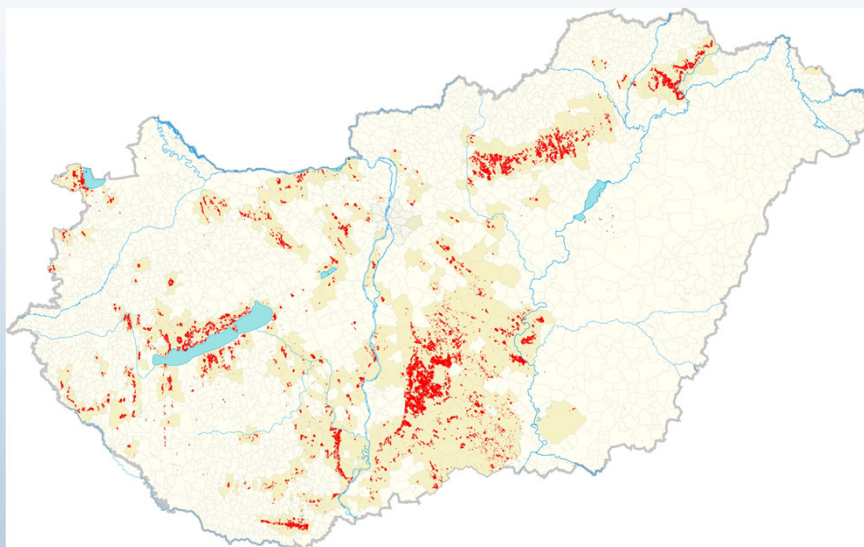


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VINGIS, IT system of Wine-growing Regions



FÖMI's activities in SDI & LA II.



- Central Data Archive and Data Services
 - All geo-related data (including historical documents) are available at Central Data Archive
 - [Operating of GeoPortal of FÖMI \(http://www.geoshop.hu\)](http://www.geoshop.hu)
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- Educational and international activities
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 - FÖMI is a Legally Madated Organization (LMO) in INSPIRE Framework

FÖMI's Geoportal: <http://www.geoshop.hu>



Termékeink:	Georeferálás nélküli raszteres topográfiai térkép	Ortofotó
Domborzatmodell	Georeferált raszteres topográfiai térkép	Szintvonalarajz
Földmérési alappontok	Közigazgatási határok	Vektoros topográfiai térkép
Földmérési alaptérkép	Magyarország Földrajznev-tára	Corine felborítási adatbázis

Vásártás Nyitólap Termékeink Árak Kapcsolat Segítség

1. Termék kiválasztása

2. Terület kiválasztása

Segédretek kiválasztása:

Közigazgatási határok

WFS WMS

Közigazgatási határok
Ortofotó 2005, 2m/px
Topográfiai térkép

Domborzat 5m

Tovább

3. Terület ellenőrzése

4. Kosár

5. Pénztár

EÖV | 655792, 239224 M = 1 : 45354

Általános szerződési feltételek | Adatvédelmi nyilatkozat

FÖMI ©2010, Földmérési és Távérzékelési Intézet
1149 Budapest, Bosnyák tér 5., Postafiók: 1592 Budapest, Pf. 585.
Tel: +36-1-222-5101, Fax: +36-1-222-5112

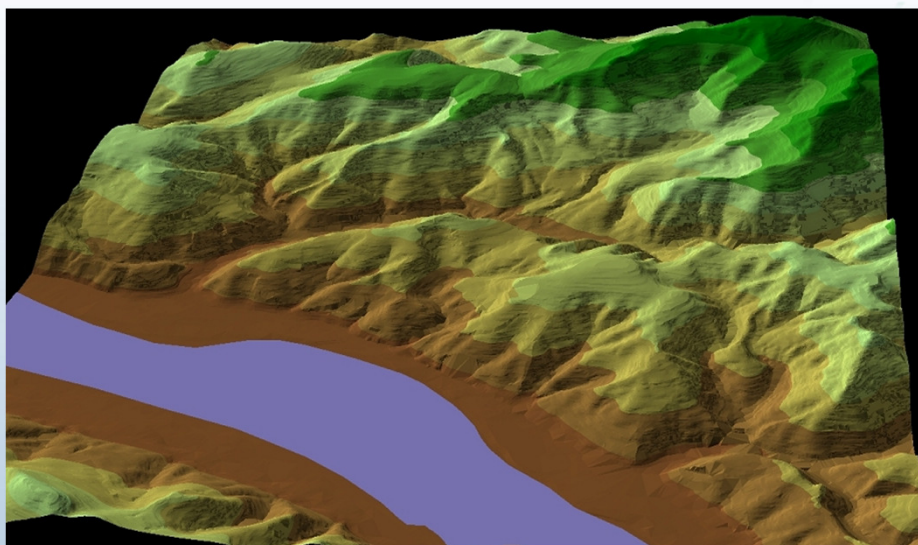
NFU Nemzeti Földmérési Szolgálat

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High Resolution (5m) DEM

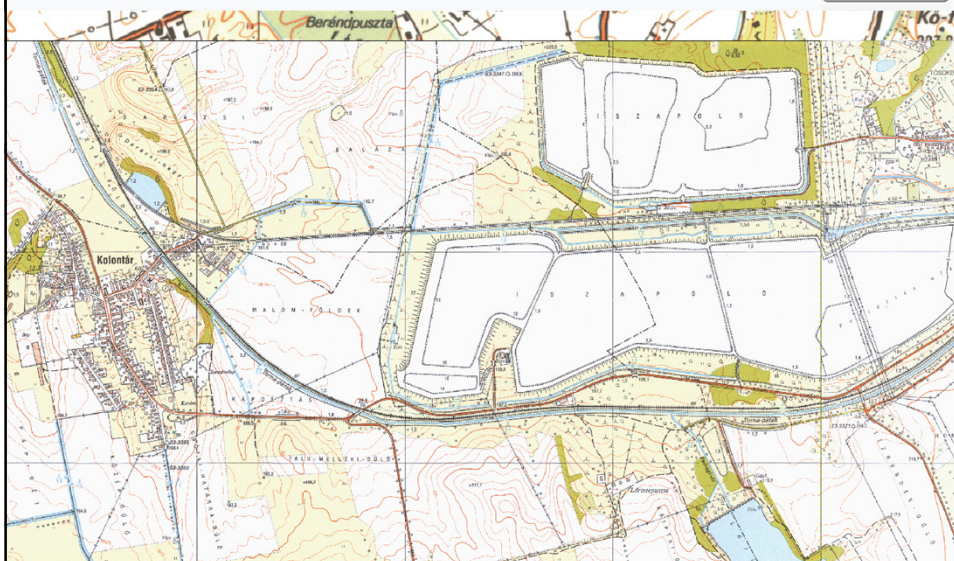


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Topomap and orthophoto database



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Real study in the collaboration of LA & SDI



- **On 4th October 2010 a red-mud accident happened at sludge reservoir of alumina factory Ajka, HUNGARY**
- **Approximately 1 million cubic meters of red-mud flooded the environment**
- **Red-mud is alkaline (13 pH value was measured!)**
- **10 peoples died in the flood because of injuries on their skin and/or the flood itself and 123 injured**
- **The Government needed different data and statistics (as soon as possible) for decision making**
- **FÖMI was asked to complete and analyse data**

The Damaged Reservoir



Cleaning on the street The level of alkaline flood!

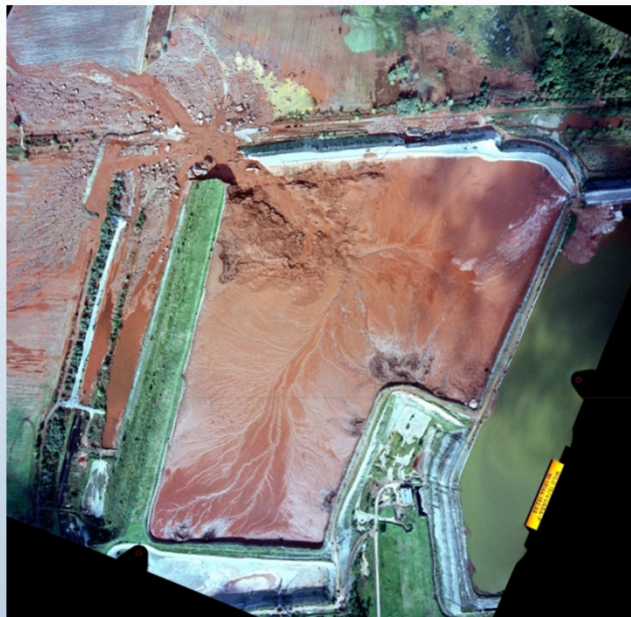


Delineation of Areas Affected by Red-mud flood



- 4 days after the disaster delineation of flooded areas started on ultra-high resolution satellite images
- Technologies based on the operational Remote Sensing techniques developed by FÖMI and elaborated for monitoring agricultural losses

Aerial Photograph about the damages reservoir



Delineation of flood on Rapideye image



Final delineation on Rapideye Image on 07.10.2010



Analyses on flooded areas by FÖMI

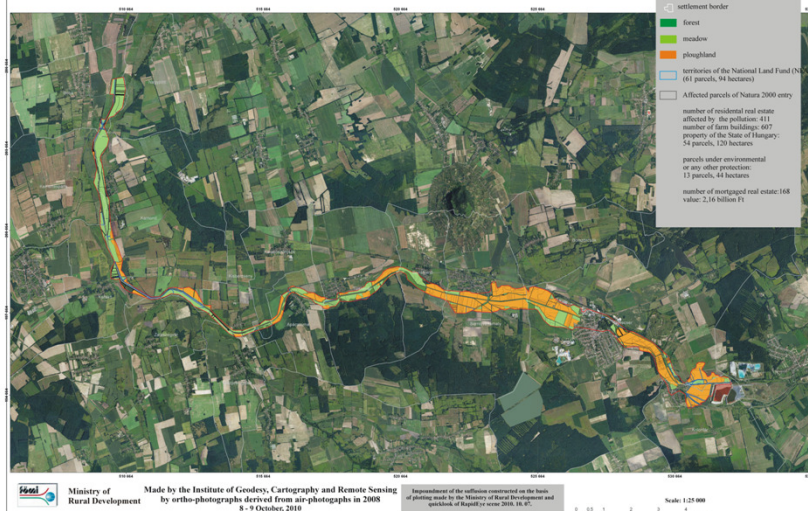


- Delineation by Remote Sensing techniques and GIS databases managed by FÖMI (e.g. Central Unified Land Registry Database, LPIS) provide a good basis for fast and effective analyses on flooded areas
- 5 days after the disaster decision makers received the different statistics, databases and maps for action

Land Use Analysis on flooded area



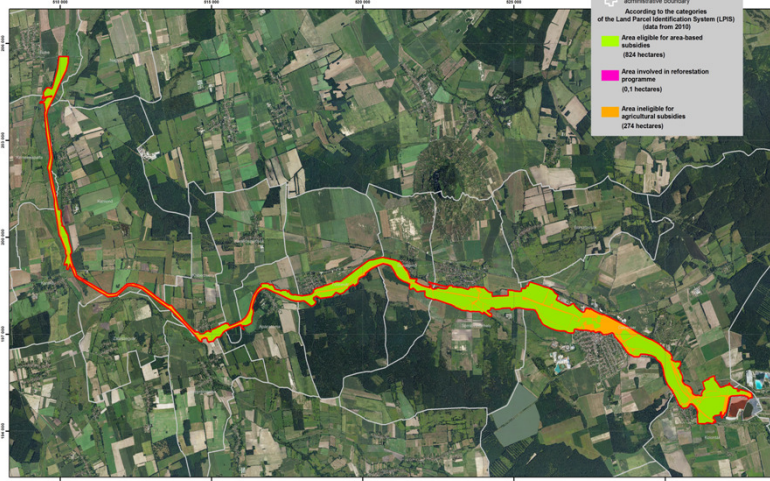
Preliminary estimation about the area of suffusion by Ajka red sludge 3. related to current register data of peripheral real estate



LPIS Categories on flooded area



Data based on the final delineation of the Ajka red mud flood according to the categories of the Land Parcel Identification System (LPIS)



- Legend**
- Flooded area
 - Administrative boundary
 - Administrative boundary according to the categories of the Land Parcel Identification System (LPIS) (data from 2010)
 - Area eligible for area-based subsidies (824 hectares)
 - Area involved in reforestation programme (51.3 hectares)
 - Area ineligible for agricultural subsidies (276 hectares)

fozi Ministry of Rural Development Made by the Institute of Geodesy, Cartography and Remote Sensing (orthophotos generated from aerial photos taken in 2008) 27th October 2010, Budapest, Hungary Delineation of flooded area based on orthophotos and WorldView-2 satellite image Scale: 1:65 000

Areas on agricultural subsidies



Preliminary estimation about the area of suffusion by Ajka red sludge 1. referred to the territory affected by the Single Area Payment Scheme in 2010



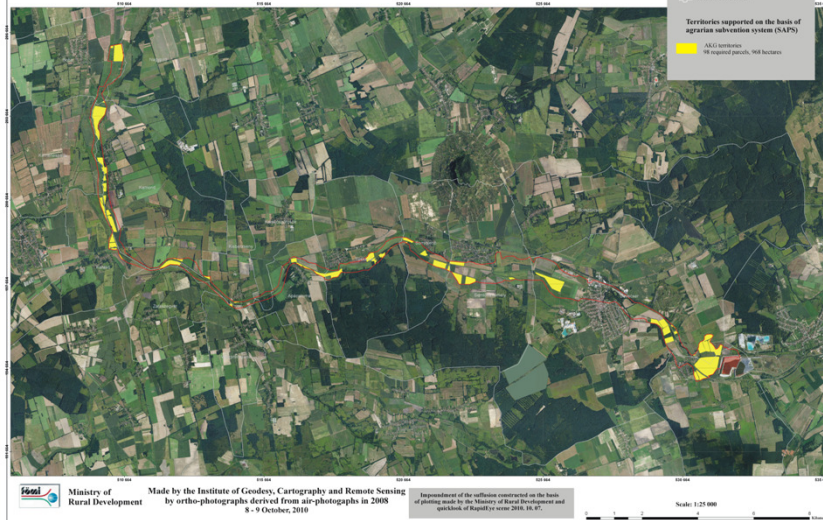
- Legend**
- Estimated wash territory
 - settlement border
 - Affected area of SAPS 2010
 - Supported territories as used by agriculture (yellow) 316 hectares
 - Supported territories as ploughland by agriculture (orange) 603 hectares

fozi Ministry of Rural Development Made by the Institute of Geodesy, Cartography and Remote Sensing by ortho-photographs derived from air-photographs in 2008 8.-9. October, 2010 Representation of the suffusion controlled on the basis of plotting made by the Ministry of Rural Development and agriculture of Hungary in year 2008, No. 97. Scale: 1:25 000

Areas in Agro-Environmental Farming Programme



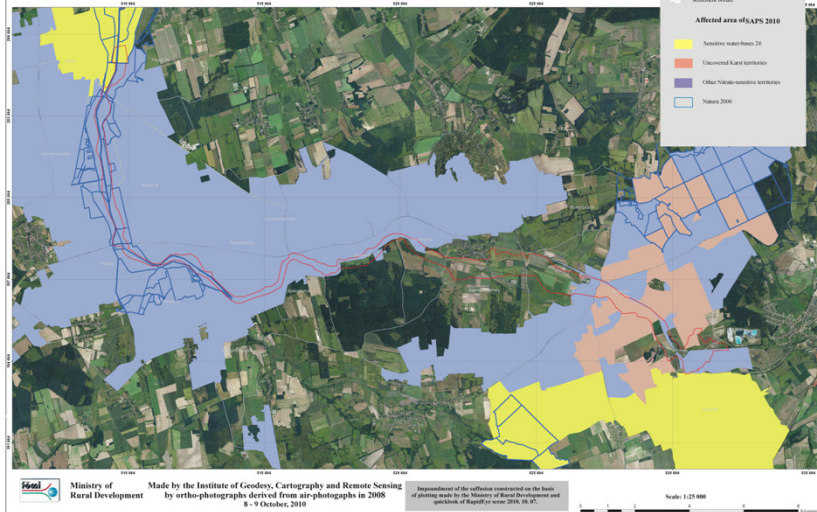
Preliminary estimation about the area of suffusion by Ajka red sludge 5. Territories involved in long-term Agri - Environmental management (AKG) scheme



Nitrate-sensitive areas next to flooded area (based on LPIS)



Preliminary estimation about the area of suffusion by Ajka red sludge 4. Impoundment of affected nitrate-sensitive and Natura 2000 territories in Agricultural Parcel Identifying System (LPIS)



Statistics based on preliminary estimation of buildings



Settlement	Number of buildings					
	Settlement			Affected by red-sludge		
	Number of buildings (total)	Number of houses	Number of buildings (for office, retail, farm and other purposes)	Number of buildings (total)	Number of houses	Number of buildings (for office, retail, farm and other purposes)
APÁCATORNA	253	95	158	6	2	4
BOBA						
BORSZÖRCsök						
DEVECSER	3813	1710	2103	725	300	425
KAMOND	546	167	379	2	0	2
KARAKÓ						
KARAKÖSZÖRCsök						
KEMENESPÁLFA						
KISBERZSENY						
KOLONTÁR	750	267	483	253	92	161
NAGYPIRIT						
SOMLÓJENŐ	515	147	368	4	3	1
SOMLÓVÁSÁRHELY	1438	449	989	23	12	11
TÚSKEVÁR	606	259	347	2	1	1
VESZPRÉMGALSA						
ZALASZEGVÁR	292	85	207	3	1	2
Total	8213	3179	5034	1018	411	607

Statistics based on preliminary estimation of agricultural cultivation



Settlement	Categories of agricultural cultivation					
	Forest		Arable land		Meadow	
	Number	Area (ha)	Number	Area (ha)	Number	Area (ha)
APÁCATORNA	10	3,3	23	27,8	29	23,8
BOBA			6	0,8	23	58,6
BORSZÖRCsök					1	0,2
DEVECSER	18	12,7	173	250,7	67	71,9
KAMOND	5	4,5	68	42,6	59	94,8
KARAKÓ	3	0,5	2	5,3	17	17,9
KARAKÖSZÖRCsök	3	2,6	2	0,3	11	6,7
KEMENESPÁLFA			2	1,9	38	24,3
KISBERZSENY	3	1,8	2	1,3	26	31,0
KOLONTÁR	3	0,7	23	59,3	12	7,3
NAGYPIRIT					8	0,5
SOMLÓJENŐ	1	12,6	13	26,6	10	20,8
SOMLÓVÁSÁRHELY	4	2,0	99	182,5	22	12,9
TÚSKEVÁR	9	8,6	14	30,2	32	39,5
VESZPRÉMGALSA			1	2,4	6	2,8
ZALASZEGVÁR			6	0,8	6	2,7
Total	59	49,3	434	632,5	367	415,7

Statistics based on preliminary estimation of affected area



County name	Settlement name	Settlement total area (ha)	Affected settlement area by estimation (ha)	Affected settlement area by estimation (%)	Affected built-up area by estimation (ha)
Veszprém	Devecser	6391	461,35	7%	75,56
Veszprém	Somlóvásárhely	2314	223,07	10%	6,1
Veszprém	Kamond	2044	173,44	8%	3,03
Veszprém	Kolontár	2165	103,09	6%	20,13
Veszprém	Túskevár	1695	97,56	6%	0,29
Vas	Boba	1091	70,32	6%	
Veszprém	Somlójenő	812	67,84	8%	2,92
Veszprém	Apácatorna	726	63,18	9%	0,17
Veszprém	Kisberzsény	527	46,47	9%	
Vas	Karakó	1032	39,88	4%	
Vas	Kemenespálya	1367	37,67	3%	
Veszprém	Karaközörcsök	709	12,66	2%	
Veszprém	Veszprémgalsa	869	5,84	1%	
Veszprém	Zalaszegvár	682	4,50	1%	
Veszprém	Nagypirít	1013	0,52	0%	
Veszprém	Borszörcsök	1177	0,15	0%	
Total:		24614	1407,54	6%	108,20

Final Delineation on WorldView2 image on 09.10.2010



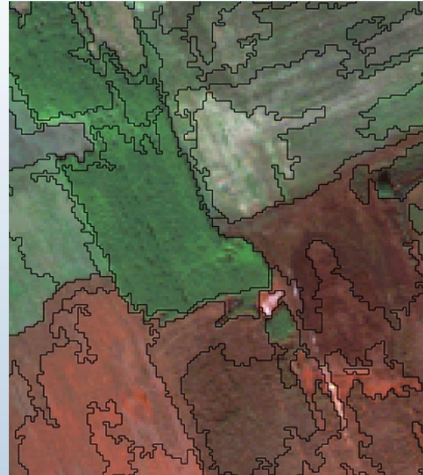
Delineation of flooded area



- No success on the field with delineation of the affected area (during the first two days)
- WorldView2 „8-band Challenge” project

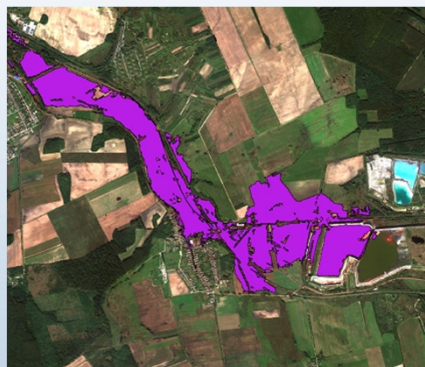
Object based:

- Analysis of additional capability of WV2
- Comparison with Rapideye images
- Comparison with pixel-based methods

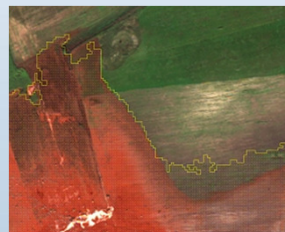
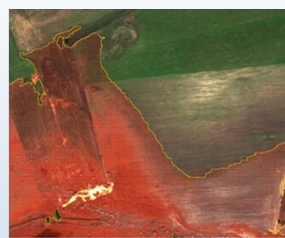


Segmentation following boundaries

Automated Red-mud flood delineation by object-based classification with eCognition

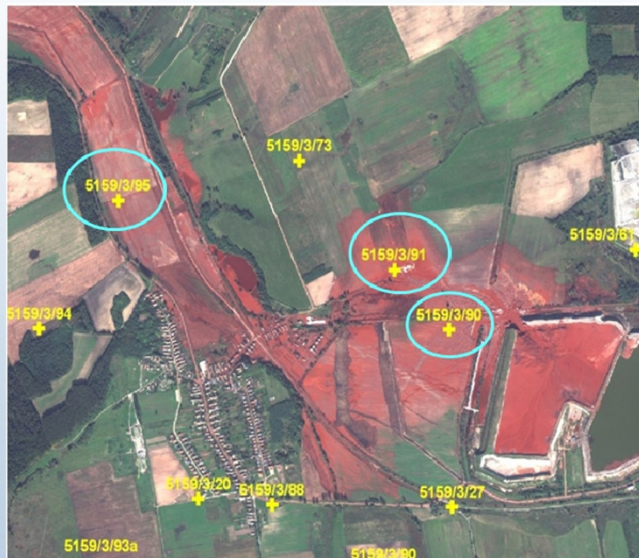


Result of Classification



And its accuracy:
up: WV2, down: RapidEye

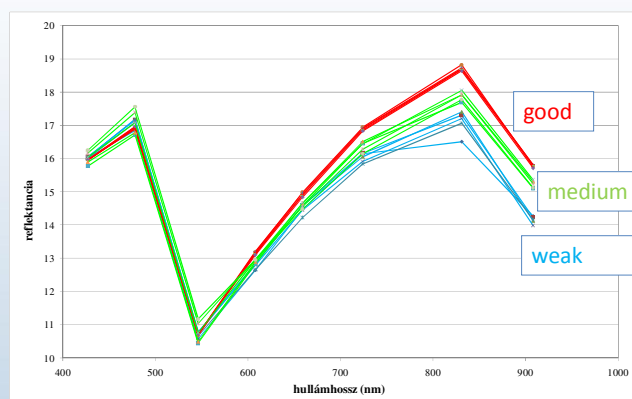
Sample points of Soil Information System by Kreybig on WV2 image color-composite (on 09.10.2010)(R: 5, G: 3, B: 2)



FÖMI analysed spectral characteristics of the environ of sample points (blue) with 2, 4, 6, 8, 10m radius

ID	Soil
5159/3/95	Gravelly
5159/3/90	Adobe Gravelly
5159/3/91	Muddy Clay

Spectral Characteristics of Flooded Sample Points and their environ with different physical property in WV2 spectral bands



Based on Leachment properties the largest difference is on the near-infrared bands (800-1000 nm)

ID	Soil	Color	Leachment	Water Keeping
5159/3/95	Gravelly	Red	Good	Weak
5159/3/90	Adobe Gravelly	Green	Medium	Medium
5159/3/91	Muddy Clay	Blue	Weak	Good

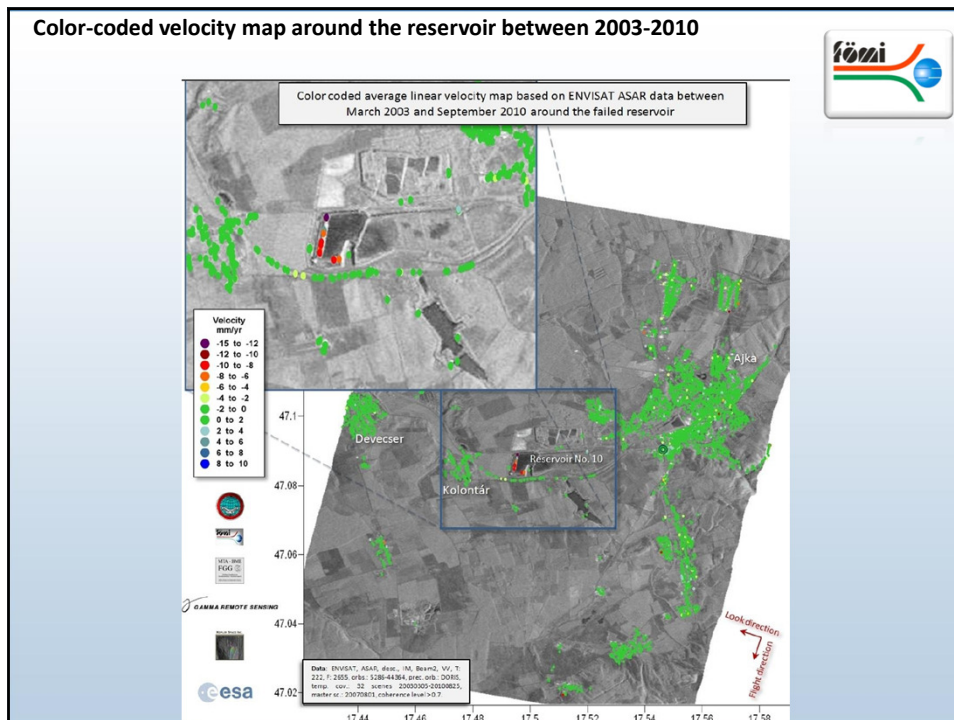
Motion and stability monitoring by InSAR technology

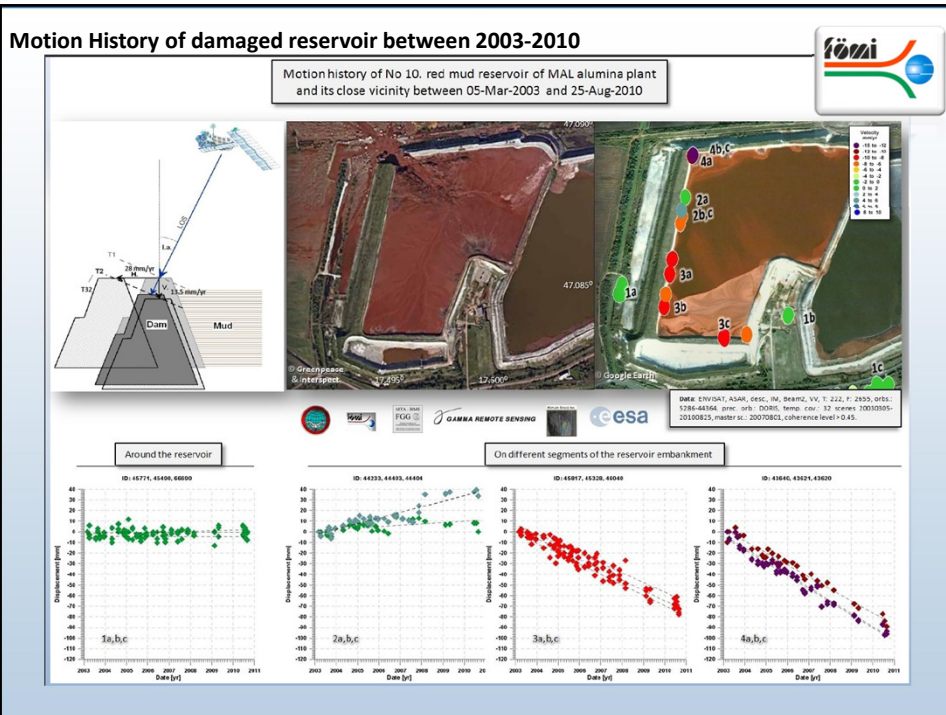
(Working together with Urs Wegmüller – Gamma Remote Sensing Ag., Switzerland)



- Limitation on Ground and GPS measurements in motion and stability monitoring:
 - No Historical analysis, results only years after
 - Measurement of High-density built-up areas is expensive or impossible
 - Ground works, network development and measurements are needed
- InSAR technology (DInSAR and PSI techniques)
 - No need for:
 - Point Marking
 - Instrument
 - Ground works
 - Waiting (we have 19 years time-base)
 - Other Advantages:
 - Very high vertical accuracy
 - Very high Spatial Resolution
 - Measurements are available monthly
 - Technique is very useful on built-up areas
- InSar at FÖMI
 - Satellite Geodetic Observatory of FÖMI has a R+D project for the utilization of InSAR technology, which were used in monitoring of red-mud flood

Color-coded velocity map around the reservoir between 2003-2010





FÖMI's recommendation for monitoring dangerous objects by geodetic and other technologies

- Preparation phase
 - Geodetic and Geoinformatic surveying
 - GIS Databases (DEM, Cadastre, Topography, Orthophoto, Land Registry, Remote Sensing Databases etc.)
 - GNSS Services
 - Measurement of motion-history of dangerous objects by InSAR technology (if possible)
 - Elaboration of monitoring technology instructions
- Monitoring of Dangerous Objects
 - Establishment of Local Monitoring Network
 - Determination of Network Points by traditional methods (e.g. GPS, Total Stations, Levelling)
 - Fit this network to HGRN (Hungarian GPS Geodynamics Reference Network)
 - Monitoring Measurements
 - 1D – Monthly InSAR analysis + Levelling
 - 3D – Based on Risk Level
 - Systematic GNSS measurement campaign OR on-line, continuous, real-time monitoring on local or on GNSS Service based technologies
- Data Analysis and Guidance
 - Geophysical Interpretation of Measurements
 - Change management by GIS technics

Further planned analyses around flooded area

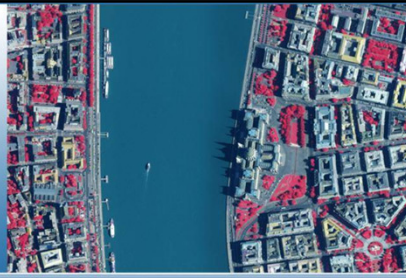


- Remote Sensing techniques are able to serve accurate data in long term via measurement of damage of vegetation and the result of releasement
- Comparison of agricultural areas based on time-line satellite images before and after the flood:
 - Condition of Vegetation
 - Changes of Seeding Structure
 - Yield Analyses
 - Weed Infection Analyses
 - Continuous Monitoring of Environmental Damages by Remote Sensing

Conclusions



- FÖMI, as a part of Hungarian Land Administration plays an important role in National SDI
- Red-mud flood disaster showed, that the integration of different databases, technologies and knowledge base results a good and flexible service for decision makers, which raises the appreciation of our profession
- Integration of new technolgies, such as InSAR, and the traditional ones (GPS, etc.) has a great potential in disaster management



Thank you for your attention

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