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DROMAS

Agricultural Crop Monitoring and Assessment driven by Satellites

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Presentation outline

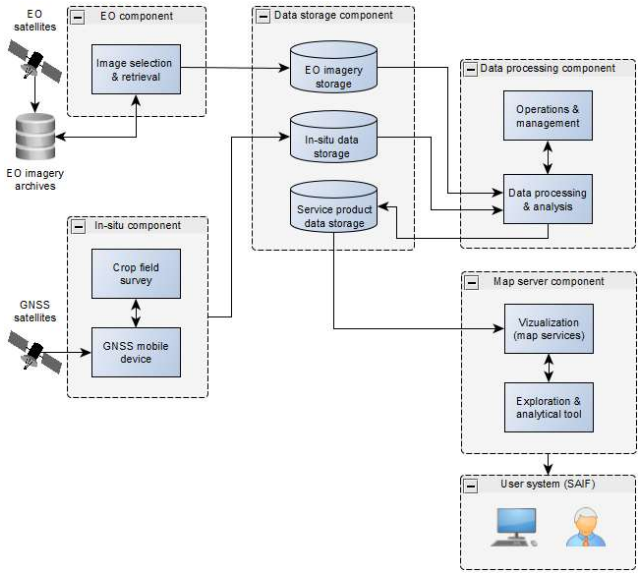
- Project background
- System architecture
- DROMAS services
- Demonstration activity
- Validation & assessment
- Outlook to the future

Project background

- ESA ARTES Integrated Applications Promotion (IAP)
  - Feasibility study (2013 – 2015)
  - Demonstration project (2016 – 2019)

- Main objectives
  - To implement operational full country crop and grassland monitoring service provided to the Czech Paying Agency
  - To support IACS control processes within the eligibility check of agricultural subsidies
  - To support the process of continuous LPIS update and contribute to the improving the quality of the LPIS.

System architecture I



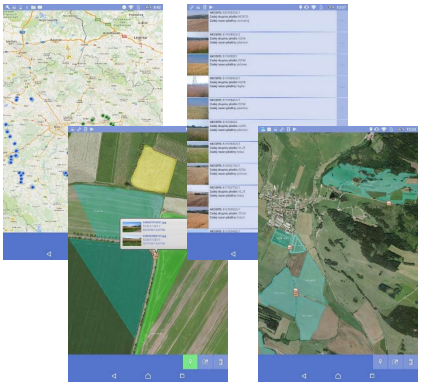
System architecture II

EO component

- Automated EO data retrieval (Sentinel 1&2, Landsat 4,5,7,8)
- Multiple sources, queries can be parametrized

In-situ component

- mobile application for in-situ data collection
- on-line transfer of the collected data (position, photos, attributes) into central database



System architecture III

Data processing component

- Automated EO data pre-processing
- Multitemporal compositing and temporal interpolation
- Crop separability analysis
- Automared time-series analyses
- Multiple classification approaches (per-pixel/per-parcel, ML/OBIA, …)
- Validation tool

- Technical solutions
  - Mostly based on open-source tools
  - Artificial intelligence (machine learning, neural networks), decision trees, object oriented image analysis (OBIA)
  - Big data enabled - can be run locally or deployed on the cloud (DIAS, AWS)

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System architecture IV

Map server component

- Based on in-house developed open-source visualization framework
- Highly interactive, tailor-made data access and exploration
- Attractive, simple, user-friendly and intuitive interface

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DROMAS Control Services I

- ✓ **Crop diversification**
- ✓ **Prohibition of cultivation of certain crops on sloping agricultural parcels**
- ✓ **Prohibition of grassland ploughing**
- ✓ **Obligations of grassland mowing**

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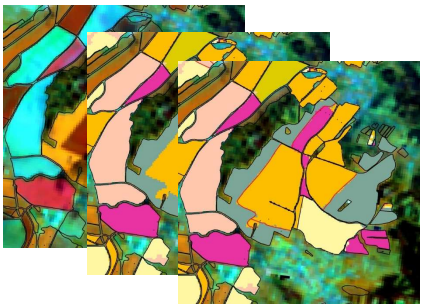
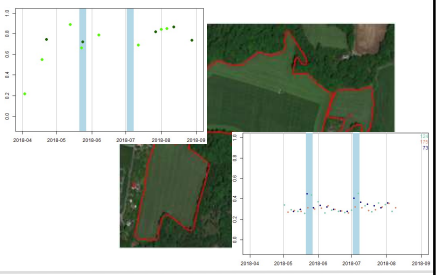
DROMAS Control Services II

- **Crop classification**
  - Combination of per-pixel and per-parcel classification
  - Automated parcel delineation (farmers block sub-division)
  - Parcel heterogeneity analysis
  - Crop separability analysis



- **Grassland mowing**
  - Generic framework for time-series analysis of integrated optical and SAR variables
  - Decision tree model allowing fine-tuning to accommodate for varying natural conditions and country specific implementations
  - Seamless integration of pixel-based and parcel-based analysis



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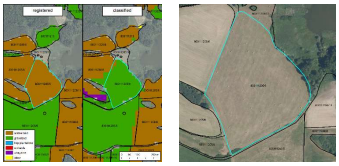
DROMAS LPIS services I

✓ **Improving the quality of the LPIS**

- Identification of "suspected" farmers blocks (in term of incorrect area, boundary, thematic category, presence of uncultivated land and non-eligible features) that are not properly represented in the LPIS
- Includes retrospective analysis to identify the year/quarter when the change that caused the LPIS problem occurred
- Automated screening of LPIS to identify farmers blocks with incorrect thematic categorization

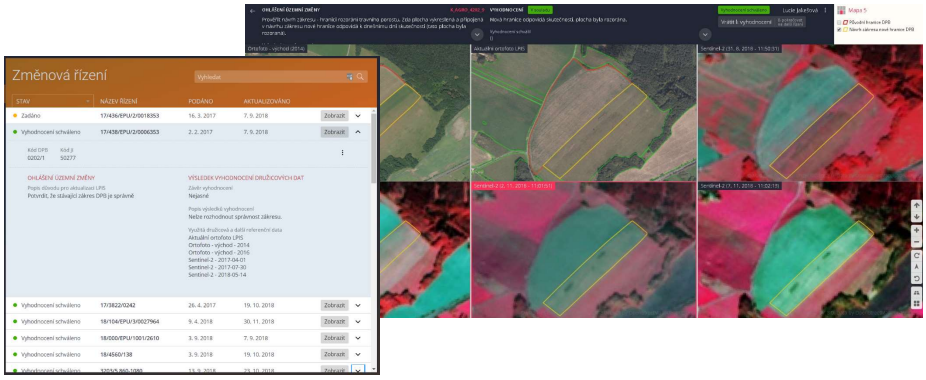


- Automated identification and delineation of non-eligible areas

DROMAS LPIS services II

✓ **Support to LPIS update process**

- quick “on-line” check of LPIS update requests submitted by farmers to identify cases that need specific attention and additional effort to process the request



Demonstration phase

- Operational service demonstration run in 2018
- Some services demonstrated in full country mode, others in regional mode

- Specific focus on ground truth data collection
  - Dedicated field surveys run by Gisat and SZIF
  - Farmers interview focused on grassland management
  - Use of OTSC findings

- Close collaboration with SZIF
  - Control services provided to the On-the-spot Checks, IACS and CMO Department (SZIF)
  - LPIS services provided to the LPIS and GIS Department (SZIF)
  - Regional offices involved in operational testing of the service supporting the LPIS update process

Validation & assessment

- Internal validation done by Gisat, external validation done by SZIF
- Crop classification (crops/crop groups): overall accuracy ~ 90%, individual main crop accuracy (F-score) 80 - 95%, potatoes 55%
- Grassland mowing: average success rate of correct identification of mowed/grazed parcel was above 90%
- LPIS thematic categorization check: overall accuracy 92%, individual category accuracy (F-score) 84 - 95%, orchads 50%

- Service assessment done through 4 KPIs (input data assessment, accuracy assessment, delivery time assessment, on-line service performance)
- Dedicated questionnaires prepared for Control and LPIS services

Few quotes from the SZIF assessment

Improving the quality of the LPIS

- detection of errors with almost 90% accuracy in the test area
- the service may significantly improve the quality of LPIS

Support to LPIS update process

- supporting the regional offices in LPIS update procedure
- most actual data for operators –> increases credibility against farmers
- reducing costly and time consuming field inspections

DROMAS in perspective of future monitoring

- crop mapping will be an inherent part of the monitoring process
- mowing/grazing monitoring will be effective tool for both alerts and penalties
- high accuracy of grassland ploughing detection (over 93%) is promissing

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Outlook to the future

- Demonstarted services are ready for operarational provision
  - LPIS services to be provided in 2020
- Development of additional services, continuous pilot testing and demonstration is desired by SZIF to get prepared for the implementation of checks by monitoring
- Project extension close to be confirmed

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Acknowledgment

- ESA: Project co-funding
- SZIF: Close collaboration (user requirement specification, IACS data provision, external validation, consultations)
- MoA: LPIS data provision