



# **Evolution of land cover and land use mapping in Romania**

GIMES Operational Capacity Workshop

25-26 March 2010

Sofia, Bulgaria

# The context

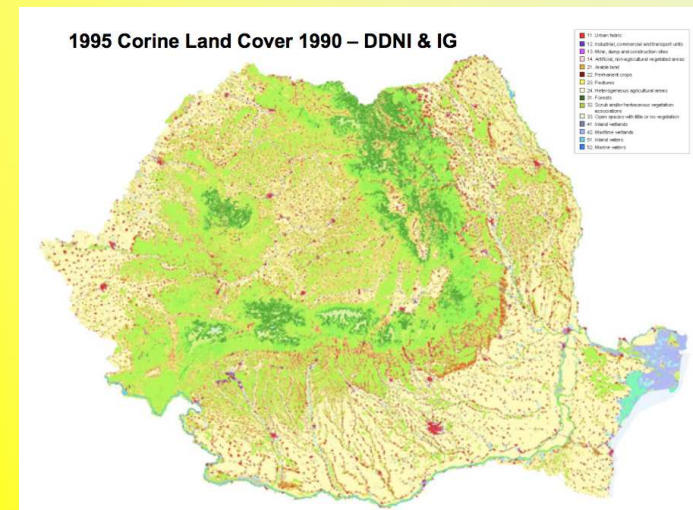
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- European initiatives and policy asking MS to provide spatial information on land cover and land use
- Global initiatives promoting standards on both classification systems and data collection methodology: UN FAO LCCS, GlobCover
- Better access to data allowing production of land cover products
- Evolution towards land monitoring core and downstream services



# Status – Land Monitoring

- EU CLC developed and updated: 1990, 2000, 2006;
- UN FAO LCCS applied since 2004 to develop and update land cover data
- Collaborative network of national organizations led by INCDD (Danube Delta Institute and) for CLC, ROSA and CRUTA (Centre for Remote Sensing Applications in Agriculture) for LCCS
- Actions taken towards setting up a national service complementary to the GMES core service for land monitoring



# LCCS – Land Cover Classification System

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- The first steps for building the LCCS products were done in 2002 with “Land Cover/Land Use Inventory by Remote Sensing for the Agricultural Reform ” – TCP/ROM/2801 , a project funded by FAO and co-funded by national R&D projects in the Aerospace Program (managed by the Romanian Space Agency - ROSA)
- project executed by a consortium: Romanian Space Agency, Romanian Centre for Applied Remote Sensing in Agriculture, Research Institute for Soil and Agrochemistry, Geography Institute Romanian Academy, Spiru Haret University - Geography Department



# LCCS Methodology

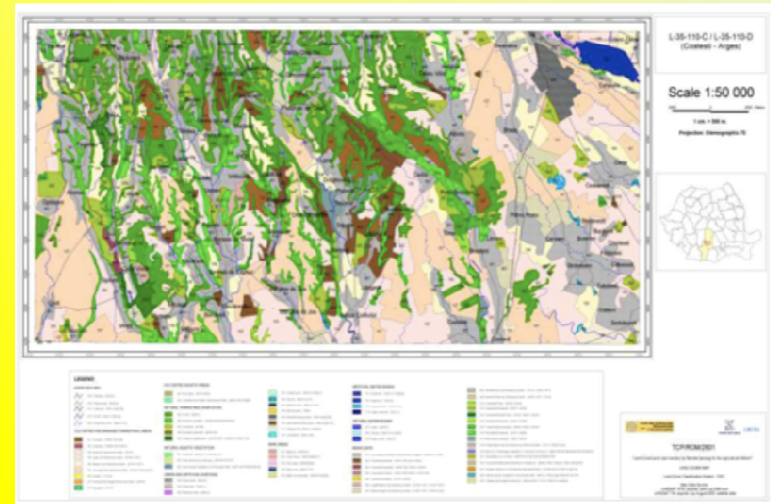
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- Mainly based on operator work i.e. image interpretation based on “keys”
- Orthorectified Landsat imagery
- Validation done based on field work
- All maps produced in the national CRS
- 61 classes defined, adapted to the national territory, based on LCCS



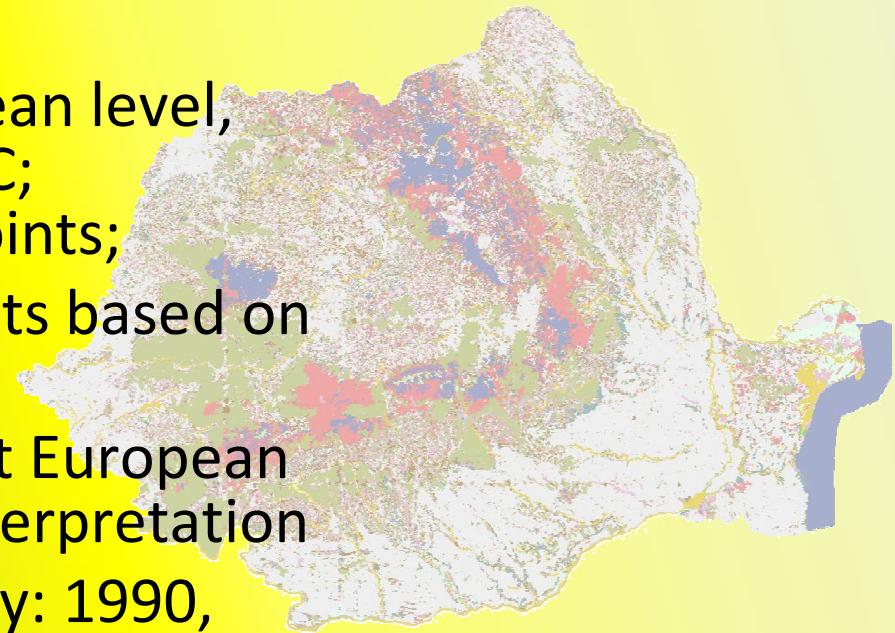
# LCCS Products

- Project finished in 2004: land cover database and maps 1:50 000 – national coverage
- Update performed starting with 2006, ended in 2008;



# CLC

- Continuous work done since 1990 under the coordination of the Danube Delta National Research Institute
- Project organized at European level, coordinated by EEA and ETC; participation of MS focal points;
- Derived from Image products based on Landsat, Spot and IRS
- Methodology – as agreed at European level – all manual, visual interpretation
- Main advantage – continuity: 1990, 2000, 2006



# Evaluation

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However

- The CLC / LCCS MMU does not satisfy all the needs expressed by the national users especially those of county and city level (the Urban Atlas is not yet available)
- The methodology currently used is taking very much time (aprox. 2 years)
- A larger set of products related to LC/LU mapping would be needed, with different resolution characteristics
- Better accessibility to data, products and services is desirable



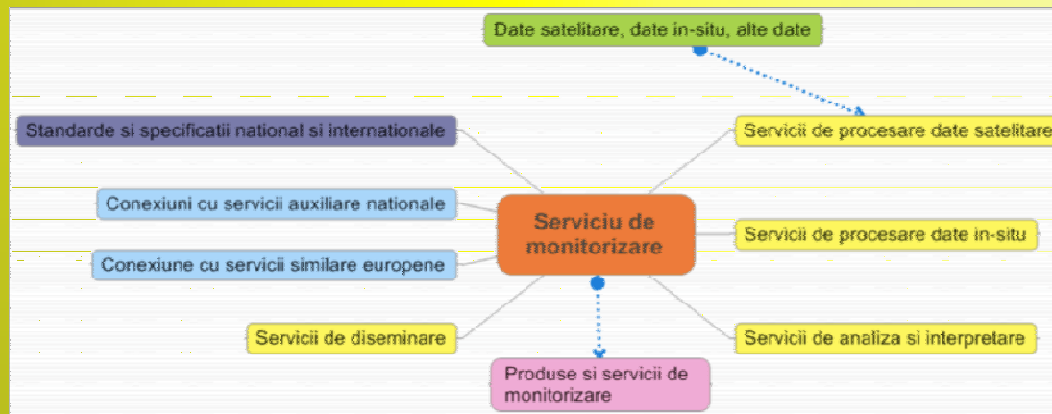
# Actions taken

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- Use financing opportunities offered by the National Program for RDI to support projects addressing: selection of the best and more mature methods for LC/LU mapping, development of knowledge on new software technologies, EO sensor data and state of the art processing algorithms
- Participate in European projects and conferences addressing LC/LU mapping, standardization and interoperability
- Use the new framework created by the PECS, as Romania is an ESA cooperating states



# Results – data and services

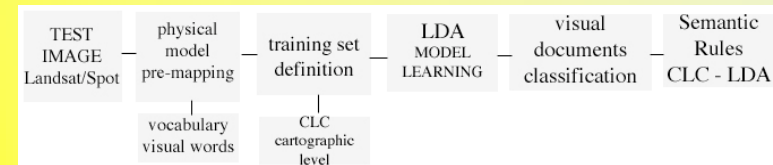


LCSS07 and MUTER – national projects directly addressing LC/LU mapping, products and methods as well as the improvement of the existing LCSS data, towards setting up a national services, complementary with EU LMCS, with a bigger set of products made available on a service portal

# Results – new algorithms

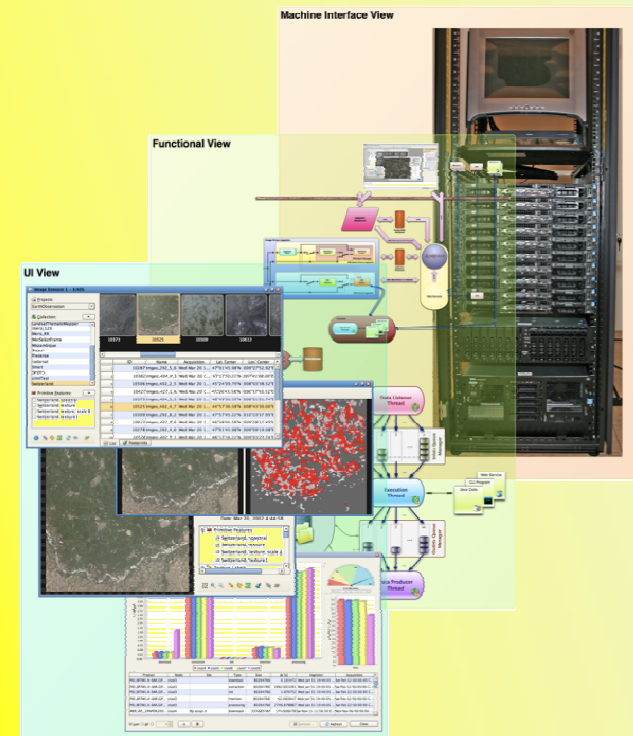
Latent Dirichlet Allocation used in land cover mapping

- Due to complex semantics the (Document, Topics) couple is more close to the CLC classes i.e. a document can get a CLC class assigned based on latent topics inside it
- The huge vocabulary in a satellite image (dynamic range) can be reduced using unsupervised methods (e.g. k-means, SoilMapper) – decrease processing time; the new vocabulary is used to identify latent topics in a document
- The dimension of documents (tiles) – function of the MMU (Minimum Mapping Unit – 25 Ha): 15x15 pixels for Landsat, 50x50 pixels for SPOT5
- Number of topics used – depend on the CLC level addressed (5, 15, 44) and directly dependent on the unsupervised process e.g. 35 words for a Landsat image
- Based on latent topics, a document can get a label according to CLC nomenclature: words  $\rightarrow$  topics  $\rightarrow$  classes
- Semantic rules can be derived for each of the classes in a nomenclature  $Class = f(topics(words))$



# Results - infrastructure

- ROKEO is a project improving the existing EO data processing infrastructure of ROSA towards providing a better answer to user needs, based on ESA KEO technology
- ROKEO will also contribute to establishing a Romanian EO portal based on ESA SSE technology
- Features: new feature extraction, visual data mining, maps and GIS server and services, integration of multi -temporal, -source EO reference data and in-situ exogenous data, EO feature server and service



# Results - infrastructure

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- KEO (Knowledge-centered Earth Observation) is a cooperative software environment providing a set of tools for EO data processing towards identification and extraction of information relevant for the user.
- Using single client software, KAOS, one can get access to KIM (Knowledge Based Information Mining) or FEP (Feature Extraction Processing), which, together with RDS (Reference Datasets) are the subsystems of KEO.
- KIM is based on a probabilistic information-mining (PIM) concept allowing the user to analyze images, extract information and export it for reuse through OGC Web services.
- FEP is a subsystem allowing the user to use a set of processing modules as well as to define new processors using the FEP designer.
- RDS is a group of heterogeneous resources (images, documents, maps, etc.) linked by geographical area, interests or topic. The management of reference data is done using the GeoNetwork catalog software application.
- KEO is currently installed in ESA (European Space Agency), DLR (German Aerospace Centre) and ROSA (Romanian Space Agency).
- More information on KEO can be found on ESA KEO project website at <http://earth.esa.int/rtd/Projects/KEO/>



# Way forward

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- Continue existing activities towards developing services that are complementary to the GMES core services for covering national, specific needs
- Better disseminate results and strengthen relationship with users
- Take more actions towards increasing awareness on the current status, the operational phase and benefits GMES can bring in the field of land monitoring
- Initiate actions towards improving data and products accessibility, training and education at all levels



**Ion Nedelcu**

Agentia Spatuala Romana – Romanian Space Agency

Cercetator stiintific /Research Engineer

Coordonator proiecte / Project Manager

Str. Mendeleev 21-25 010362 Sect. 1 Bucuresti

Tel. 021 3168722 Fax. 021 3128804

[ion.nedelcu@rosa.ro](mailto:ion.nedelcu@rosa.ro) <http://www.rosa.ro>

