EARTH OBSERVATION – CBK PAN PERSPECTIVE

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Head of Earth Observation Group





myocean.eu

brief historical introduction

XV - XVI century

the great geographical discoveries

XVIII - XIX century

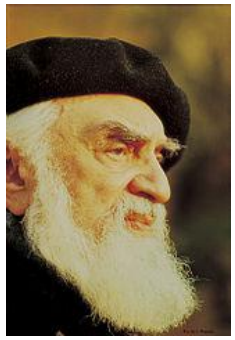
period of measurements and travels

XV – in Poland

simple in-situ methods were preferred

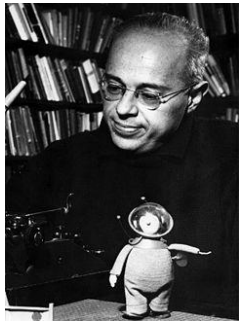
1473 - 1543

brief historical introduction



XX - XXI century - the Era of SPACE RESEARCH

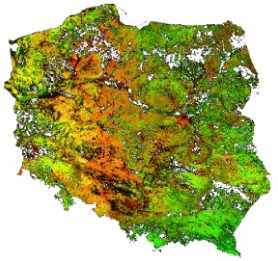
Ary Sternfeld 1905 – 1980,
born in Sieradz
co-creator of the modern aerospace science



Stanisław Lem 1921 – 2006,
writer of science fiction, philosopher and satirist

Gen. Miroslaw Hermaszewski
the first (and to this day remains the only one)
Pole in space,
he flew aboard the SOYUZ 30 spacecraft in 1978

RS in POLAND - important dates



- **1962** - RS in Poland was launched at the Faculty of Geography of Warsaw University
- **1976** - the Polish Academy of Sciences Presidium established the Space Research Centre **CBK PAN**
- **1976** - Center of Processing of Aerial and Satellite Images OPOLiS was established at the Institute of Geodesy and Cartography

- **2004** - Poland became the EU member

- **2012** - Poland became the ESA member

2012 - Poland joined ESA

2014 ESA Member States and Cooperating States

RS Activity Organisation

- Polish Space Agency is not yet established

- **Ministry of Science and Higher Education** coordinates **EU Copernicus program**

- **Ministry of Economy and PARP** supports **ESA's activity**
  PARP - Polish Agency for Enterprise Development, it acts on behalf of the Ministry

POLSA - POLish Space Agency

Polish contribution to ESA

19 mln EUR - Polish annual mandatory contribution to ESA

and its return (retrieve):

- 45% –Dedicated Fund for Poland - "Task Force" (5 years, 80% for the industry)
- 55% - on principles identical for all members of the ESA

emits

Invitations to Tender Published / Hosted by ESA

Rel. 6.0

1st Task Force

Task Fors - Polish Industry Incentive Scheme

Submitted
April 2013

73 proposals
17 mln Euro

Enterprises	***Research institutions***
54 proposals	19 proposals
14 mln Euro	3 mln Euro

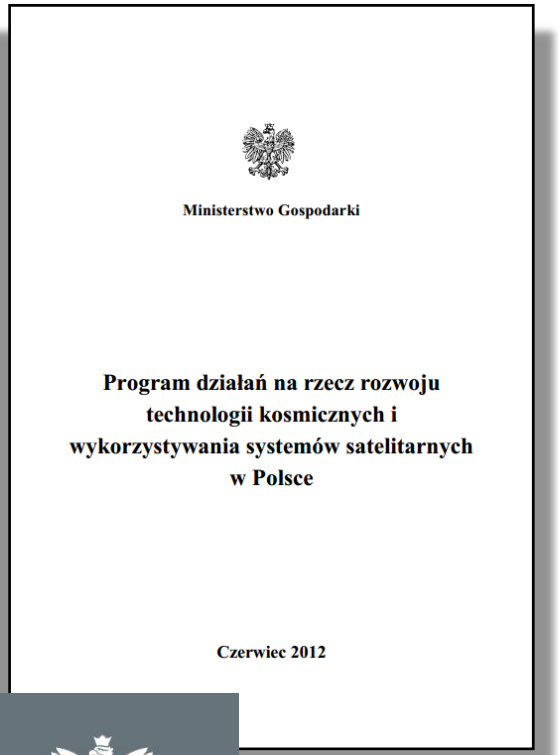
Accepted
October 2013

31 proposals
5.3 mln Euro

Enterprises	***Research institutions***
25 proposals	6 proposals
4.75 mln Euro	578 000 Euro

2ed Task Force – April 2014

The action program for Space Industry



The action program for the development of space technologies and the use of satellite systems in Poland

- Support for Polish technical participation in the BRITE project by the Ministry of Science and High Education
- Building the first Polish observation satellite
- A list of basic directions of development of Earth observation

Ministry of Economy

Future of Remote Sensing in Poland

PROSPECTS FOR DEVELOPMENT OF REMOTE SENSING IN POLAND
are extremely good

- ❑ good professional preparation
- ❑ access to the data
- ❑ access to hardware and software
- ❑ demand for remote sensing data

European Commission

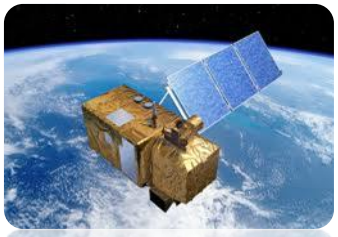
2004

esa

2012

opernicus
The European Earth Observation Programme

Sentinel satellites


Space Research Centre

of the Polish Academy of Sciences

CBK PAN

- One of the leading Polish institutes in fields of physics and astronomy, space engeneering and remote sensing
- International cooperation with more than 250 institutes
- About 70 space instruments built and sent into space

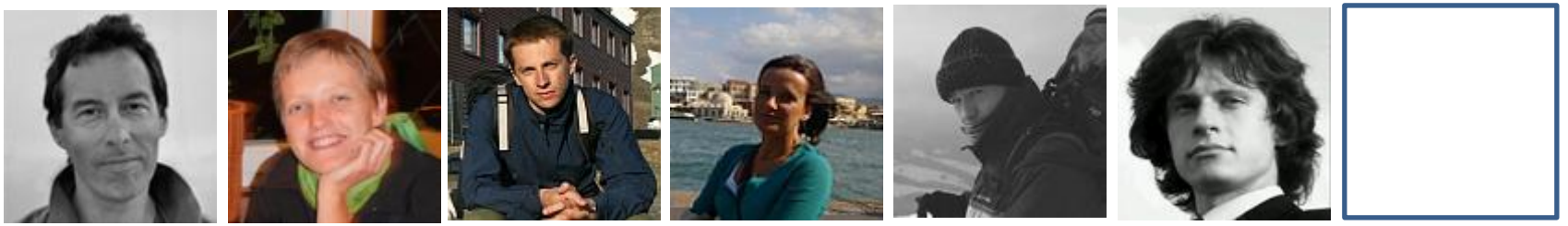
Science Departments

Earth Observation Group
Planetary Geodesy
Plasma Physics
Small Bodies Dynamics & Planetology
Space Physics and Astrophysics

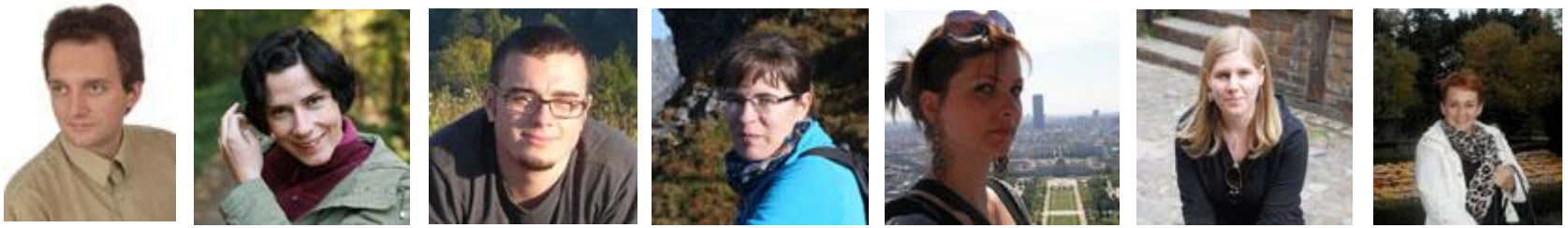
Space Technology Units

Electronic Constructions Laboratory
Laboratory of Satellite Applications of FPGA
Photonic & Micromechanics Laboratory
Space Mechatronics & Robotics Laboratory

Earth Observation Group



Crisis Information Centre



Earth Observation Group

- B-First
- SAR Classification
- GECCO
- AF3
- EDEN
- G-NEXT
- G-SEXTANT
- EOPOWER
- SPEKTROP-L
- SCARF
- ArtISS
- GLOBE

Finished

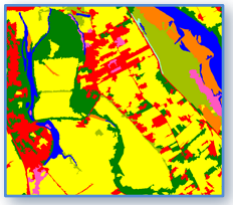
- GMES-Poland
- PEARL
- LIMES
- ASTRO+
- Tango
- G-MOSAIC
- Geoland2, SATChMo
- UrbanSAT
- GEONetCab
- Intelligent Camera
- Multifractals

Access to Software Tools and Hardware

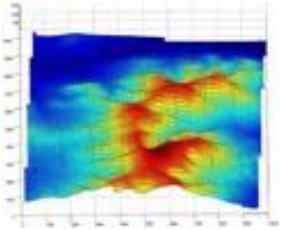
software	hardware
Image processing ENVI + IDL ERDAS Imagine PCI Geomatica	Computational node (claster) 256GB RAM 64 cores (4 CPU x 16) @ 2.1Ghz 2 x Windows 7 Prof. 64 & Debian GNU/Linux
Atmospheric correction ATCOR	
Object-oriented classification eCognition	Storage array 96 TB
GIS software ARC/GIS	High-end workstations
Programming tools MATLAB	

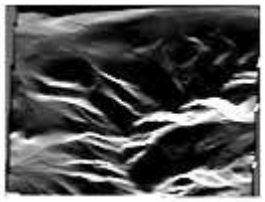
Research and application work

Land cover classification and change detection

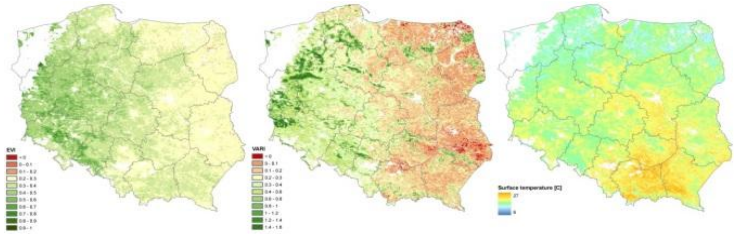


Modelling of SAR backscattering beam

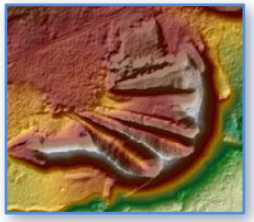




Land surface monitoring



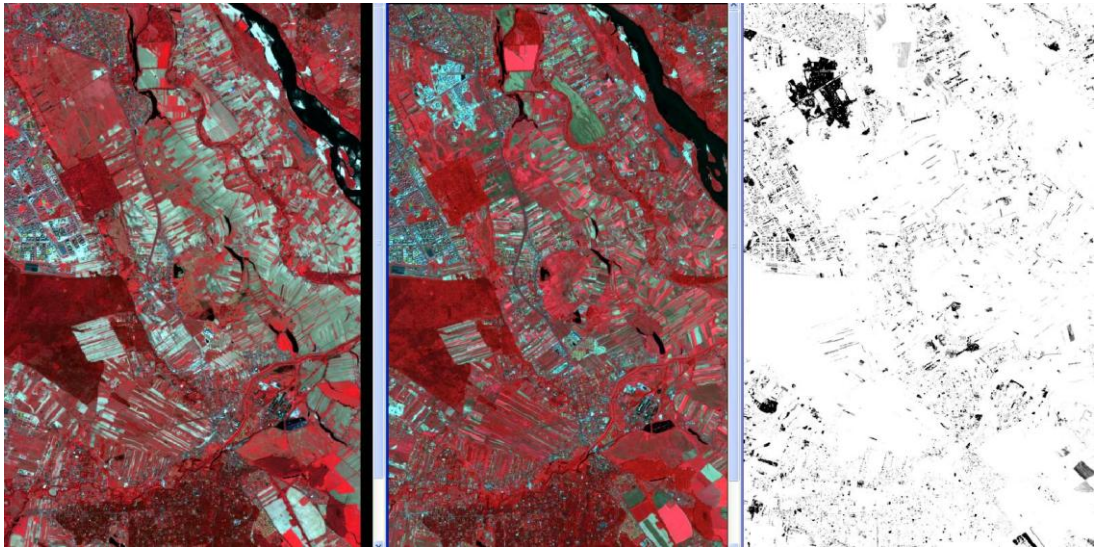
Environmental modelling

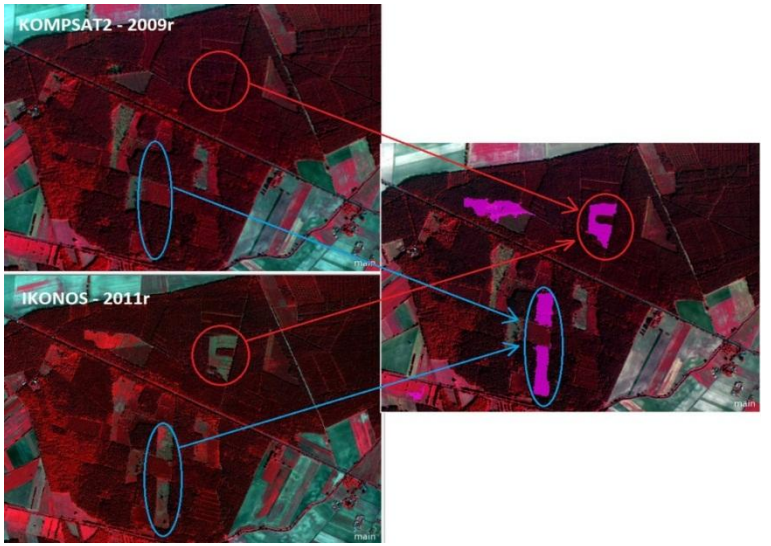


Software development and integrated applications

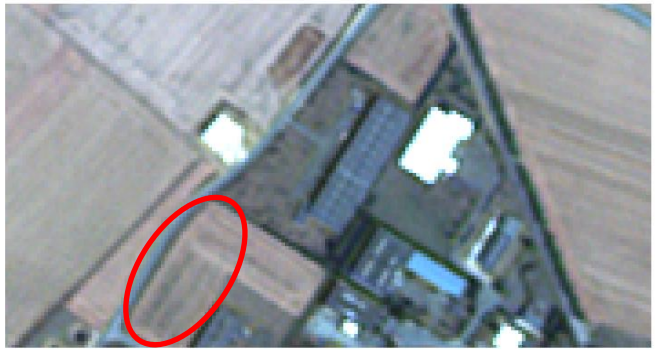
Change detection – MAD transformation

$$\begin{bmatrix} X \\ Y \end{bmatrix} \rightarrow \begin{bmatrix} a_p^T X & - & b_p^T Y \\ a_1^T X & - & b_1^T Y \end{bmatrix}$$



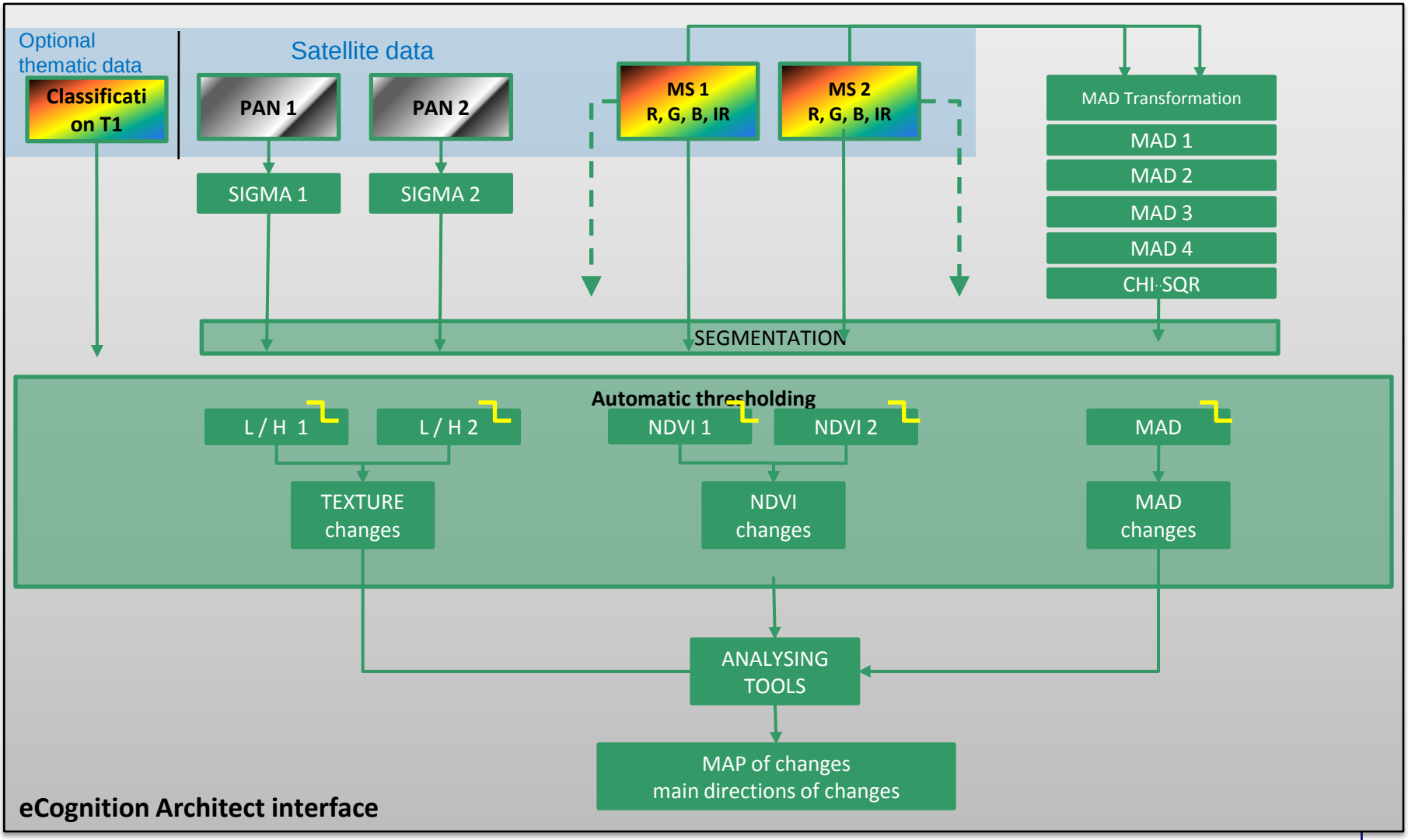


KOMPSAT-2 | 2009/08/10



GeoEye-1 | 2011/09/02

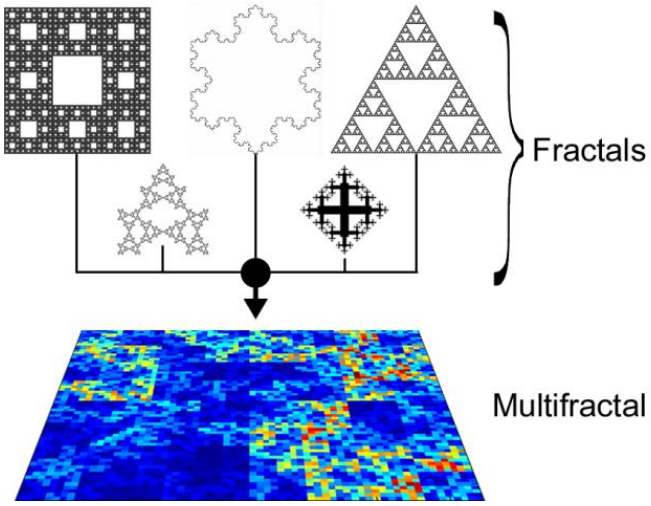
Change detection algorithm implemented in eCognition

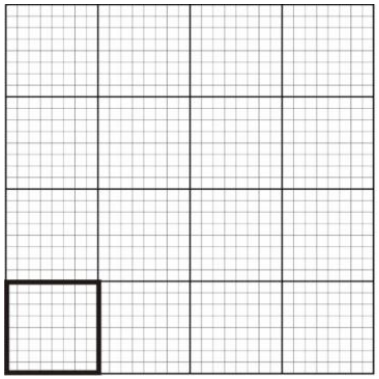


Fractal & multifractal analysis

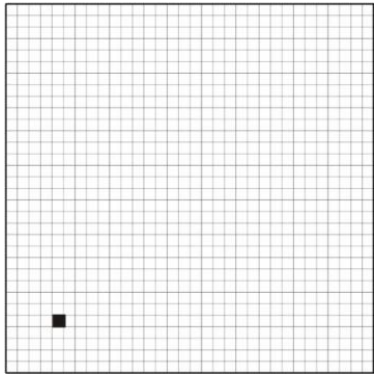
- Classification of VHR satellite images: WorldView-2, EROS-A, IKONOS
  - Comparison of selected textural features with multifractal parameters
  - Image filtration as preprocessing step for classification accuracy increase

- Change detection





global approach

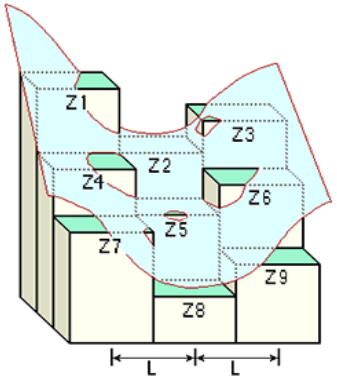


local approach

Riparian Zones -computing of delineation

(Riparian zones refer to transitional areas occurring between terrestrial and freshwater ecosystems)

THE GEOMORPHOLOGIC APPROACH
- analysis of the shape of the river valley based on DEM model

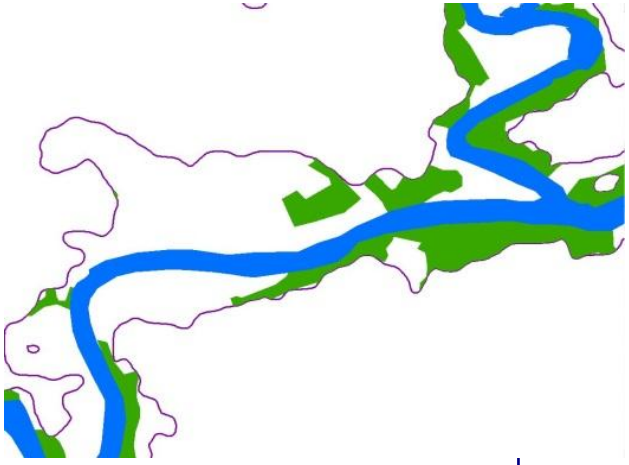


Potential Riparian Zones

border line over DEM

border line over LC classification

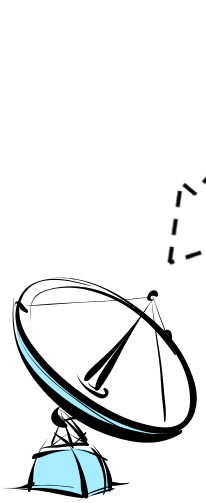
Functional riparian zones



Daily land surface monitoring

fully automatic WEB service for daily land surface monitoring

TERRA satellite
MODIS radiometer



NASA receiving station

FTP server

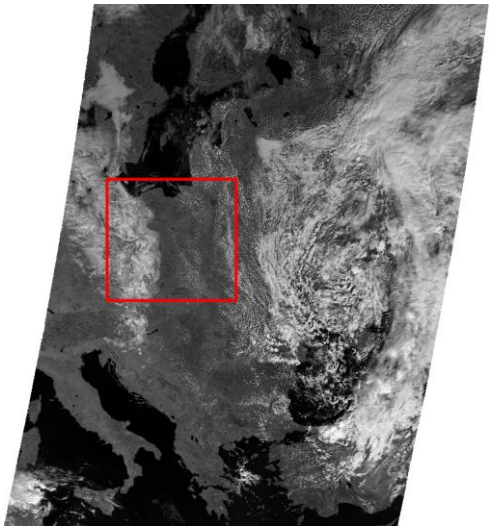
Internet

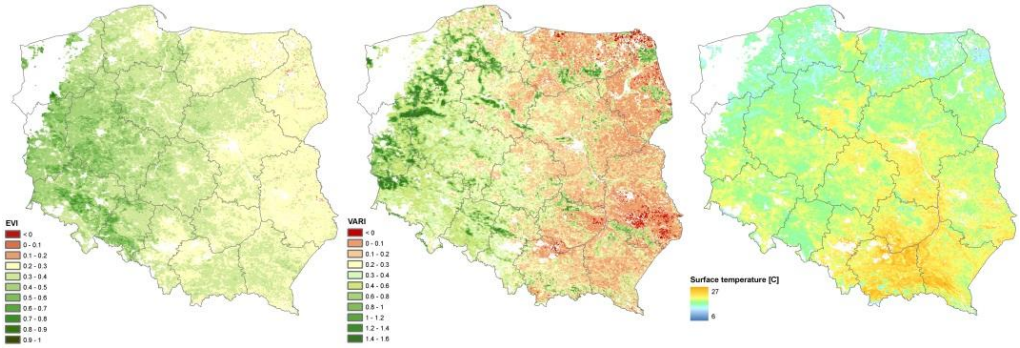
CBK PAN

GEO server

GEO portal

Daily land surface monitoring





- Vegetation indices VARI, NDVI, EVI, NDII
- Land surface temperature
- Water vapour
- Fire Hazard

MODIS

NRT data

PRE-PROCESSING

Data export from HDF format
Data merging (mosaic)
Change of projection
Extracting a subset (Poland)

CLOUD MASK

ALGORITHMS

Daily products
Decade compositions

Maps publishing

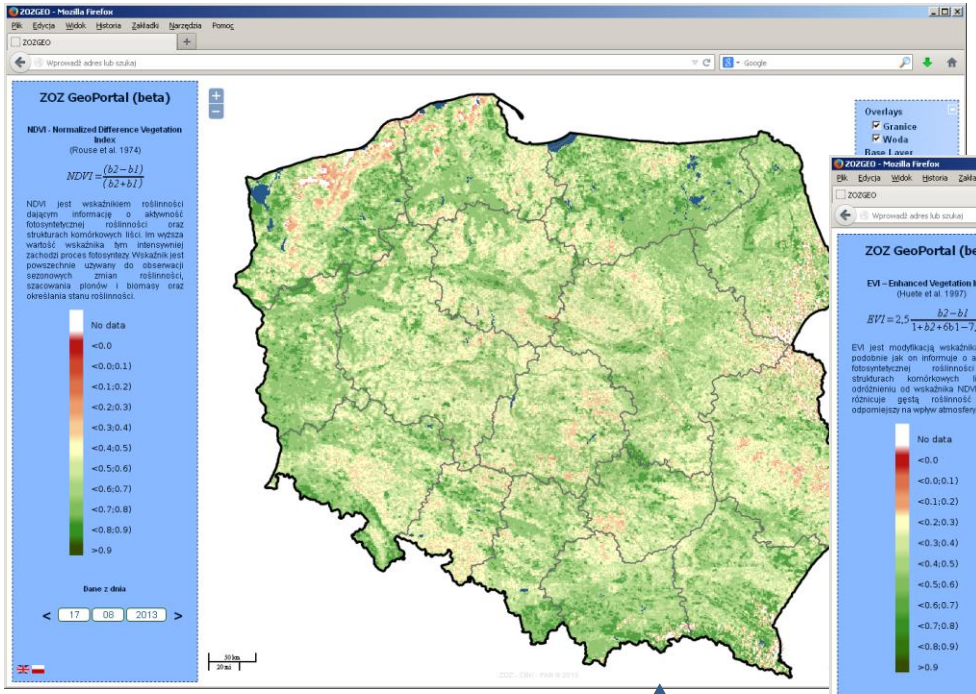
Geoserver

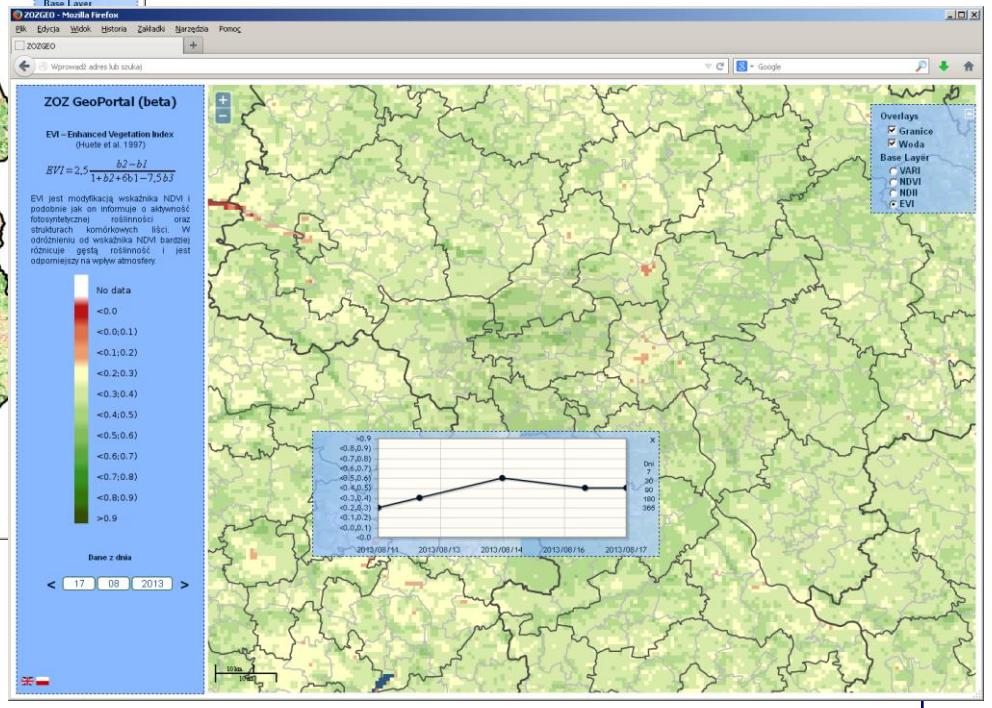
Geoportal

Daily land surface monitoring

GEOPORTAL

- Data visualization
- Access to historical data
- Visualization of time series

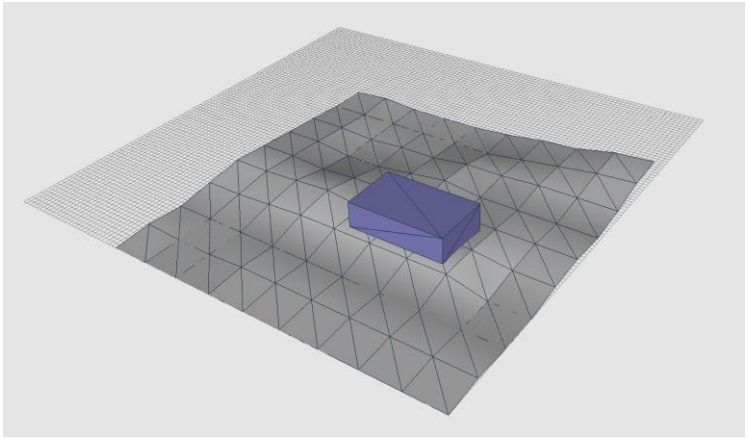


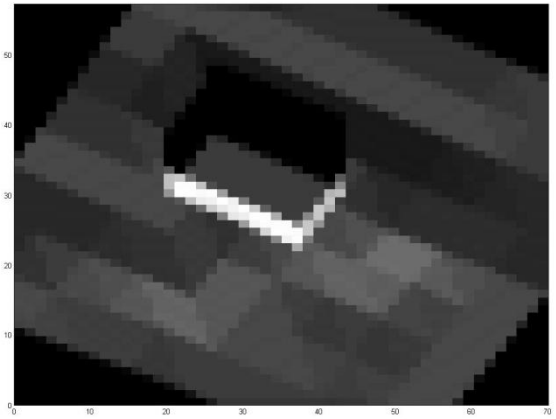


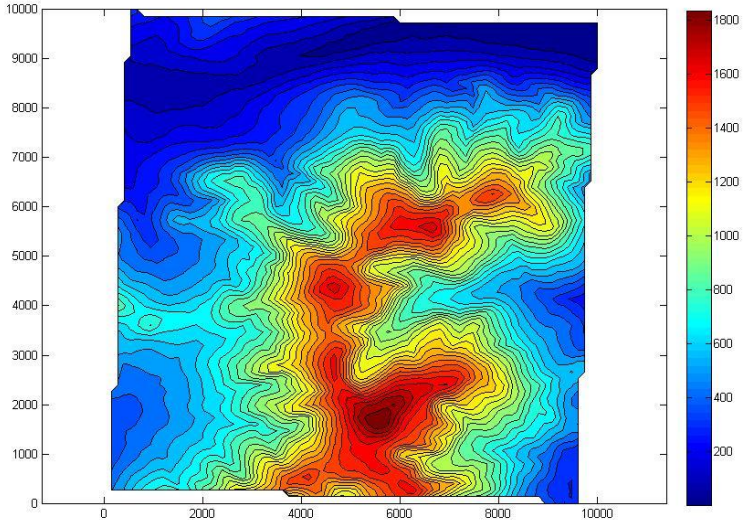
Mobile Application

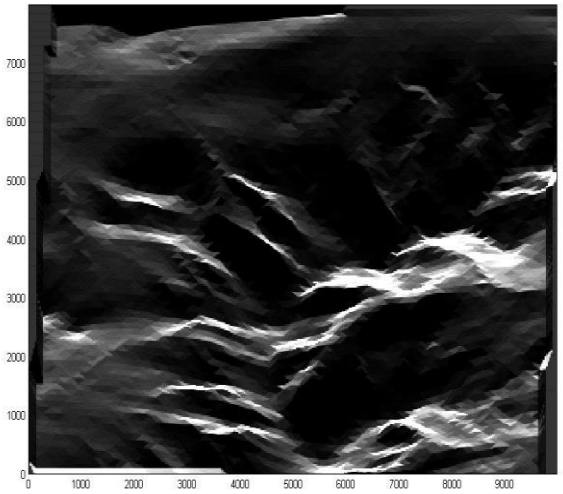
Modelling of SAR backscattering beam

Single and double-bounce SAR radar imaging simulations
by using ray tracing method



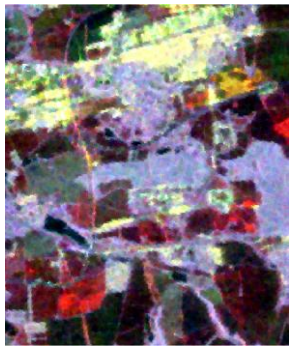




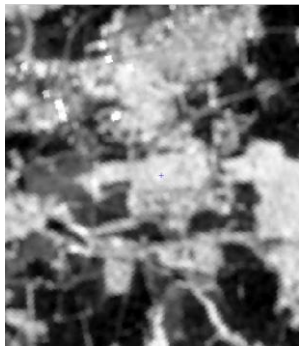


LC classification based on SAR scatter mechanism

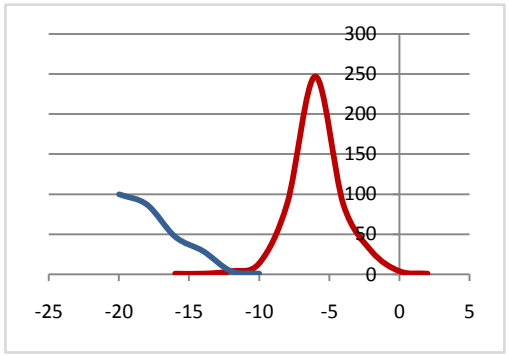
- Land cover classification based on polarimetric SAR image decompositions
  - analysis of the influence of the window size used in image decomposition on the classification results
  - verification the sensibility of the classification to threshold accuracy



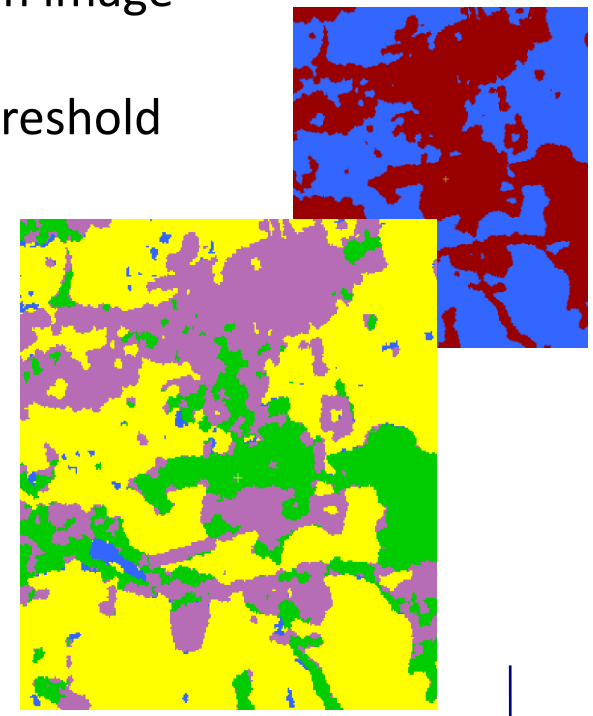
T3, C3



Decomposition parameters

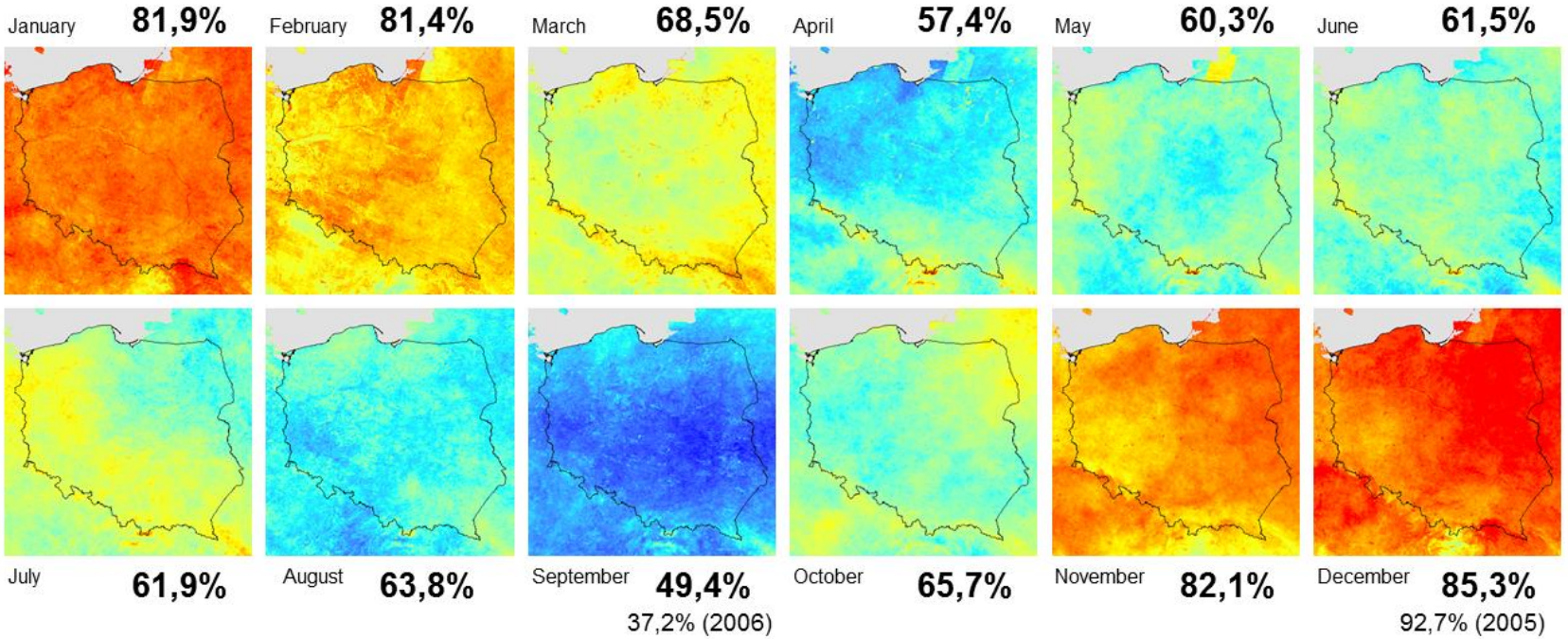


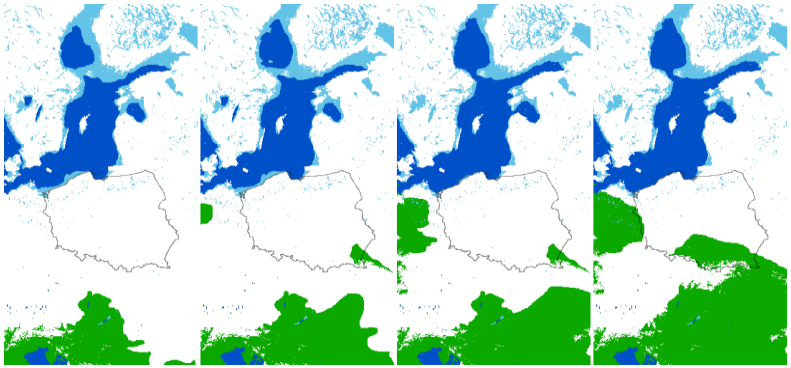
Threshold calculation



Classification and threshold sensibility study

SATELLITE CLIMATOLOGY





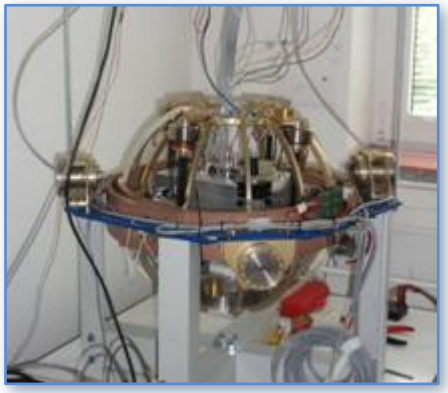
Analysis of MODIS satellite images, clouds monitoring in years 2003 - 2007

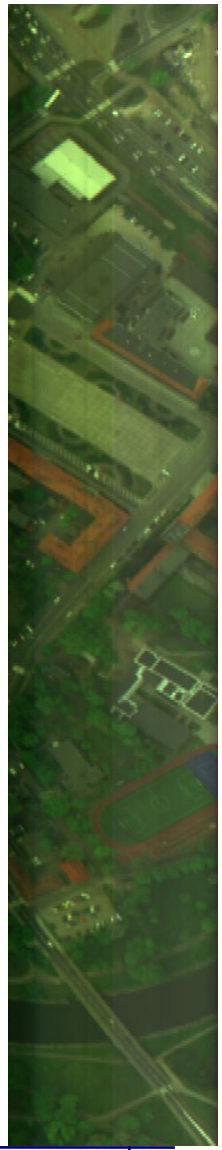
Monitoring of snow cover in Poland, analysis of NOAA-IMS data

Airborne Hyperspectral Scanner

EOG is preparing software for RS instruments developed in CBK PAN

Spectral Range: 400 – 1000nm (2nm/band)
Spatial Resolution: 1.3cm (for H=100m)
Path: 7.8m (for H=100m)





Other Sensors developed by CBK PAN:

- ❑ *Multispectral Imaging Spectrometer*
- ❑ *Fourier Spectrometer*
- ❑ *Thermal Camera*

AF3 – Advance Forest Fire Fighting

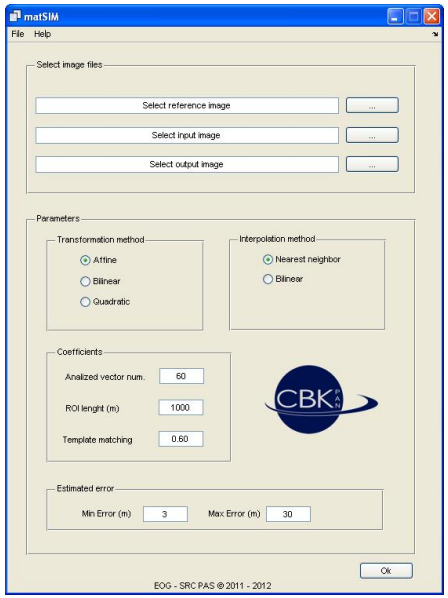
- Modelling of forest fire propagation based on satellite GIS data
- Mapping indicated infrastructure
- Mapping the distribution of vegetation type
- Calculation of water content in vegetation
- Damage analysis for vegetation and environment
- NRT mapping burnt areas and fire severity based on WEB service



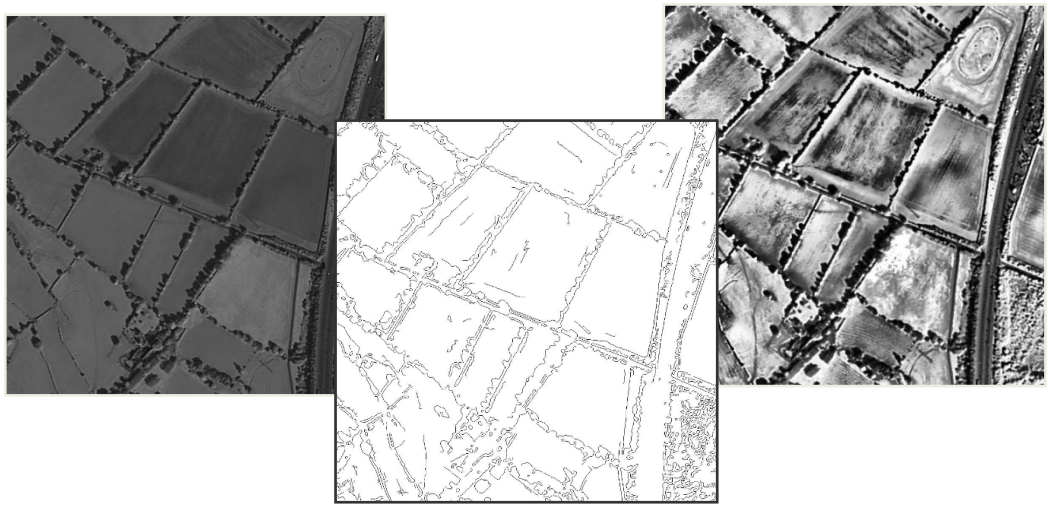

Software tools

Face recognition

Car number plate recognition

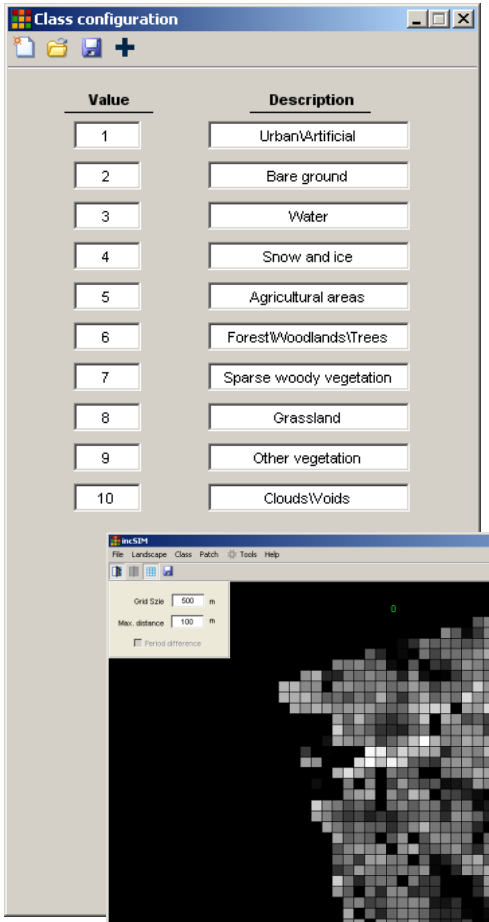


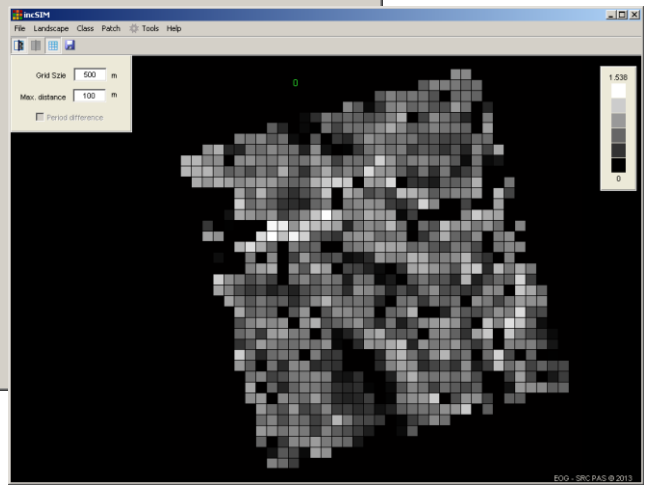
MatSIM - Matching of satellite images



Software tools

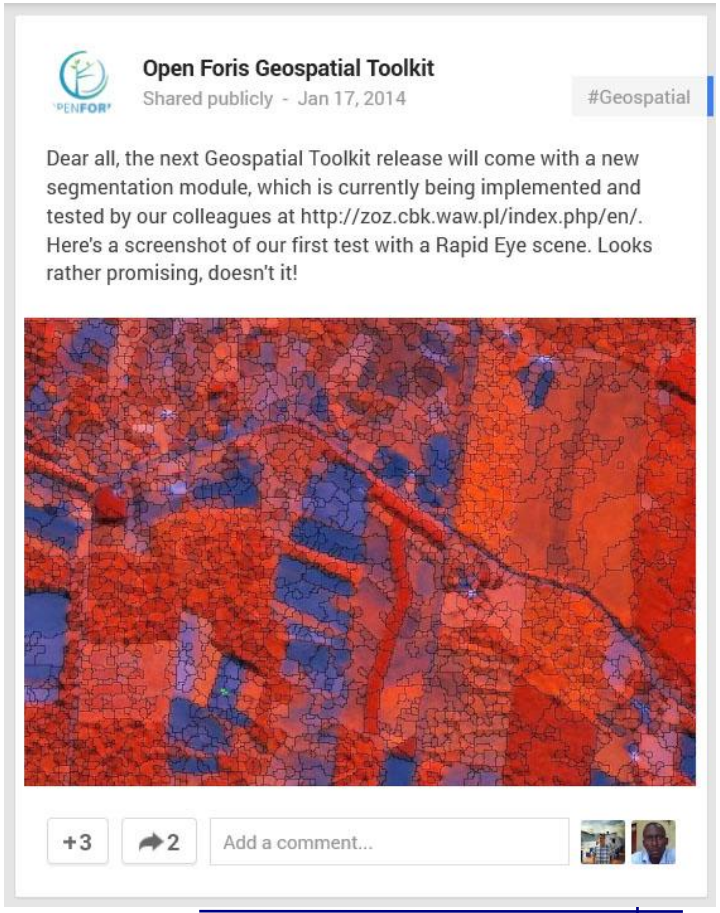
IncSIM - INdicators calculating for Classified Satellite IMages





http://zoz.cbk.waw.pl/index.php/pl/oprogramowanie

Procedure for image segmentation



BOOSTING - a novel classification method

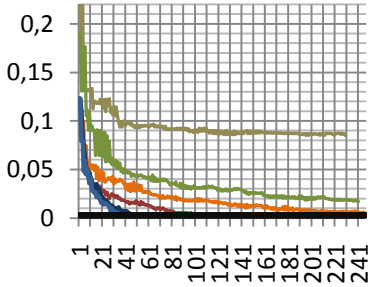
Boosting Approach - Hyperdimensional Feature Space for LC Classification

hundreds of features, e.g. 252 features for 4-band imagery

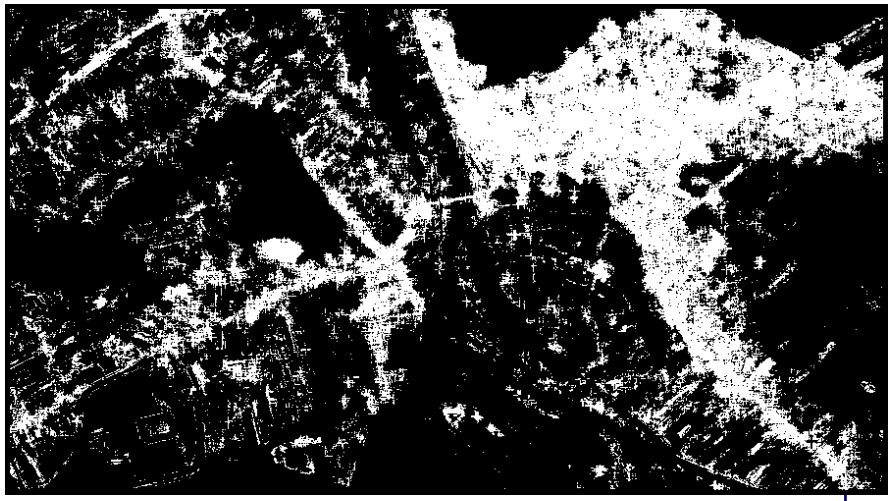
- spectral
- statistical
- structural
- frequency
- basic fractal features

Training

- Classification error
- Computational time
- Feature statistics

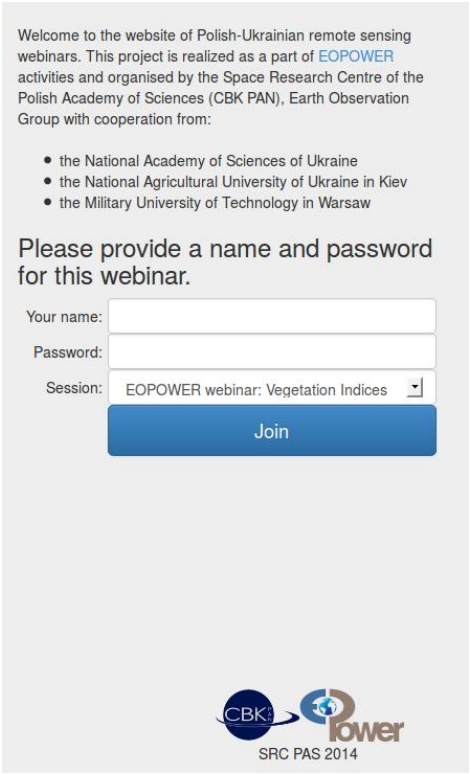


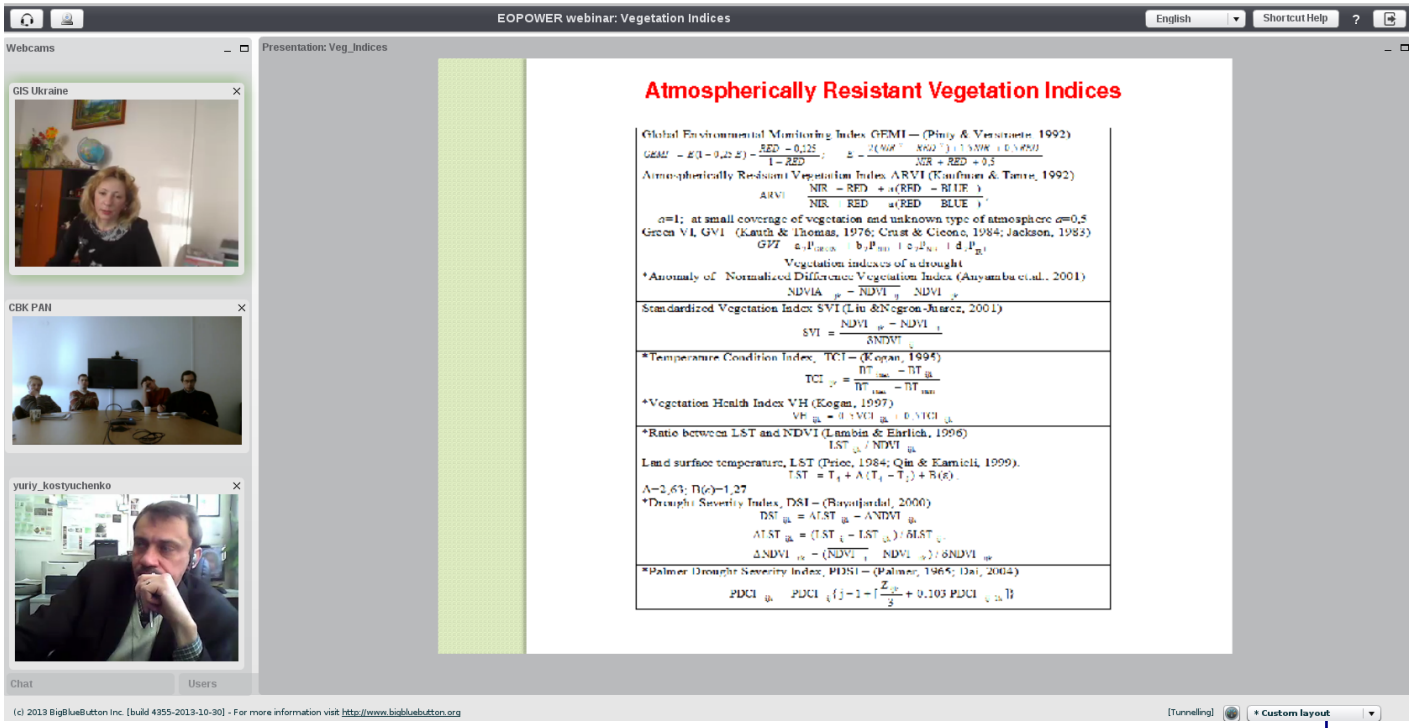
SPOT, Built-up vs. not built-up classes



Capacity Building

- Geospatial Education for Schools & Universities
- Remote Sensing Workshops
- Lesson Scenarios
- Conferences for Specialists & Stakeholders





Crisis Information Centre

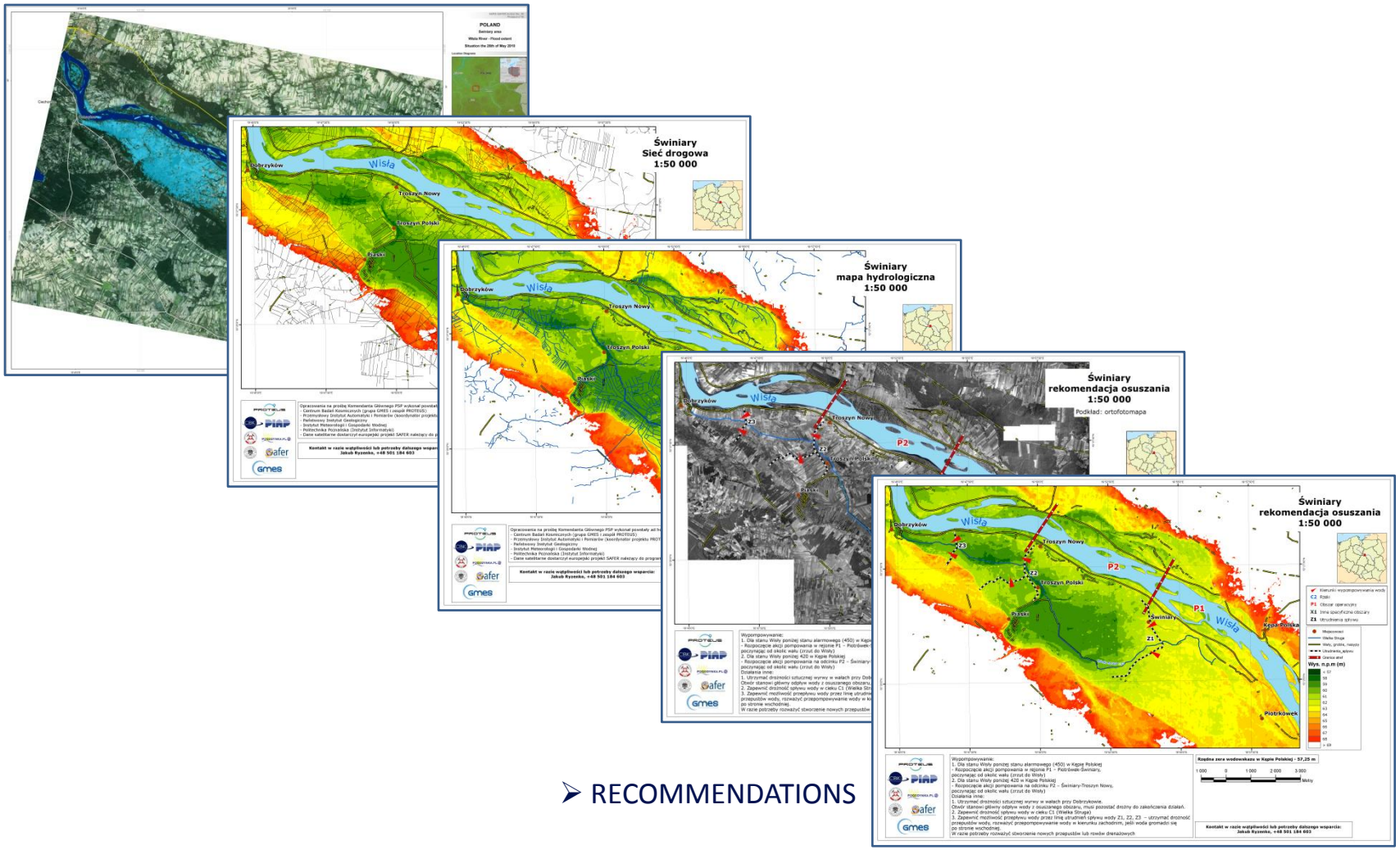
- support of the State Fire Service, institutions responsible for crisis management and Polish non-governmental organizations while using the geospatial information and satellite imagery
- development of new methods and tools in this area

- development of applications of satellite technology
- testing of new pre-operational technical solutions

CIC combines the world of science and new technology with the perspective of the user

CIC – activations

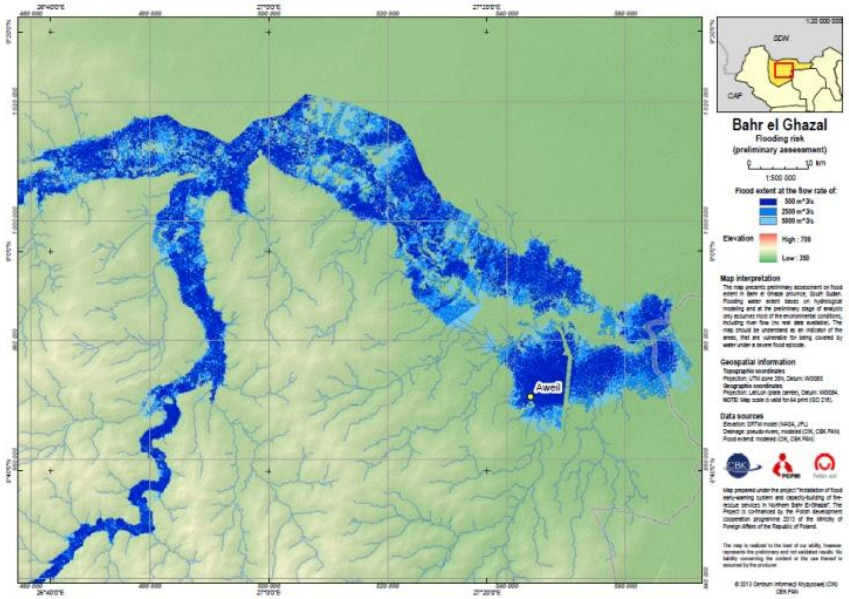
Flood in Poland - from satellite imagery to operational information

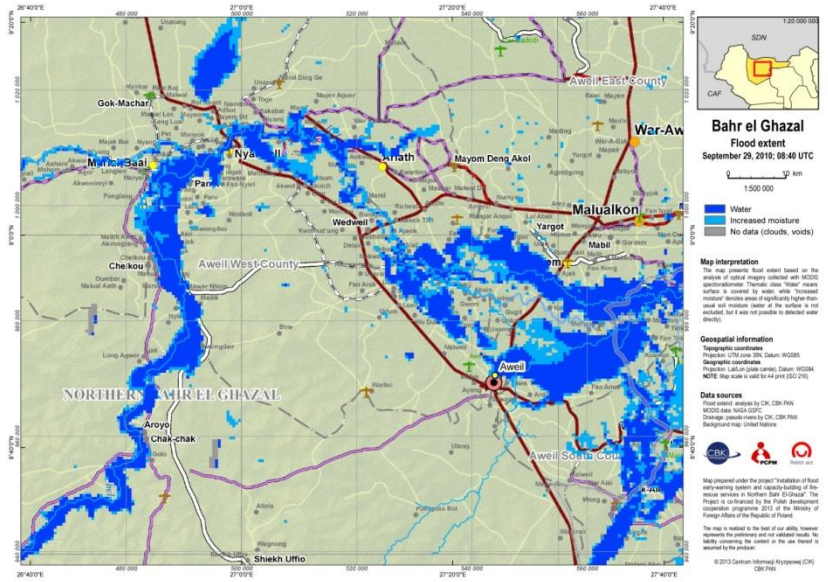


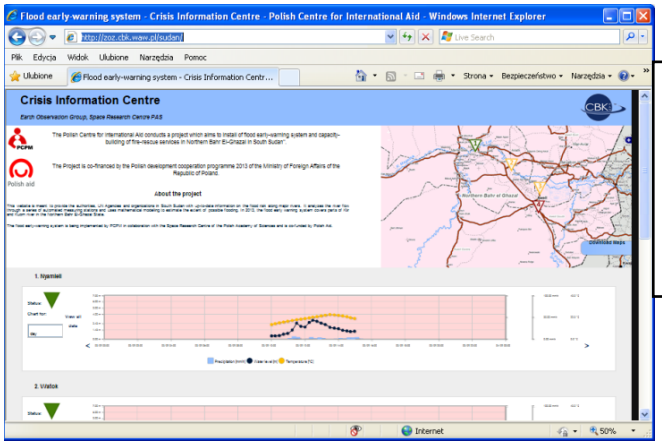
➢ RECOMMENDATIONS

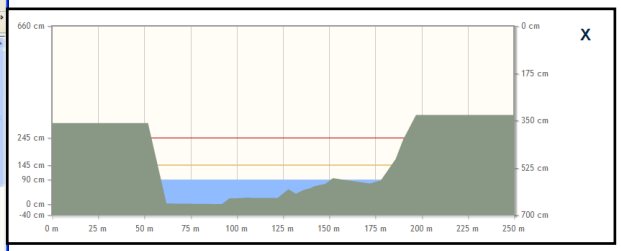
CIC – activations

Floods in South Sudan, 08-09.2013 - Flooding risk maps and Flood extent maps









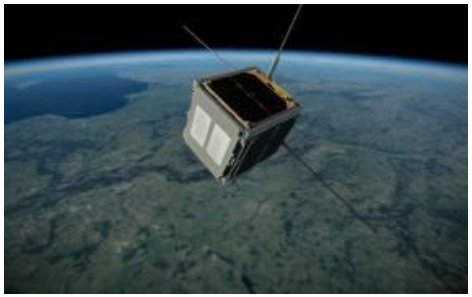
CIC - New technologies

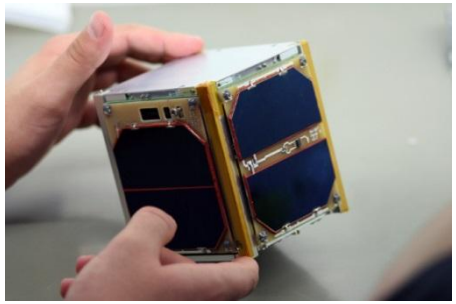
ALICE - **A**daptive **L**ayers for **I**nformation & **C**ollaboration in **E**mergency

– designed to provide the information exchange.

Polish satellites - we know how to do it ...

PWSAT 10x10 cm





BRITE PL - *Lem, Heweliusz*

EARTH OBSERVATION – CBK PAN PERSPECTIVE

Stanisław Lewiński

Head of Earth Observation Group

myocean.eu