TERRASIGNA™

EO Monitoring Solutions

Florin SERBAN, Managing Director
TERRASIGNA
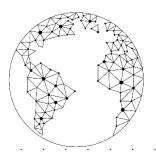
GEO-CRADLE
Regional Workshop in Romania
May 9th 2017, Bucharest

Content

△ Monitoring services based on satellite and in situ data processing

△ Big data / data mining

△ Desktop and web applications for geospatial data management

△ EO Tablet and Smart Phone Applications
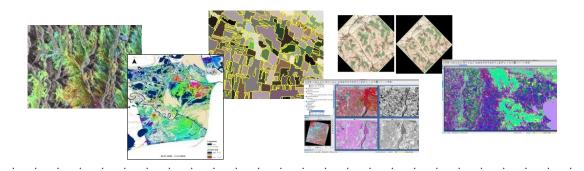
△ Ground based data acquisition sensors (radar)

Monitoring services based on satellite and in situ data processing

TERRASIGNA™

Monitoring services based on satellite and in situ data processing

⌂ **Optical, radar images processing**

⌂ **Final products:**

  ⌂ Land deformation maps; digital elevation model, change detection, flooding, deforestation, urban monitoring maps, etc

Monitoring services based on satellite images processing: critical infrastructure
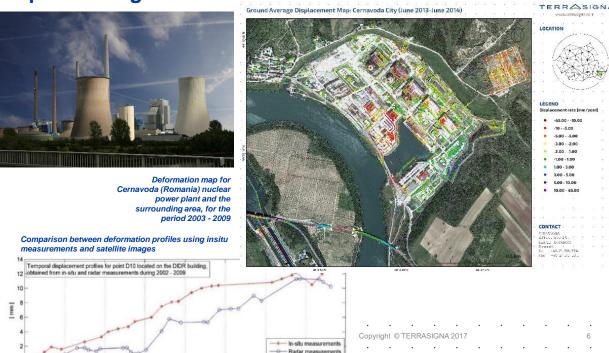

Deformation map for Bucharest Parliament House (Romania), for the period 2011 - 2014

Bucharest, Romania - Parliament House area

[mm/year]
Displacement rate
(2011 - 2014)

Monitoring services based on satellite and in situ data processing: critical infrastructure

Deformation map for Cernavoda (Romania) nuclear power plant and the surrounding area, for the period 2003 - 2009

Comparison between deformation profiles using insitu measurements and satellite images
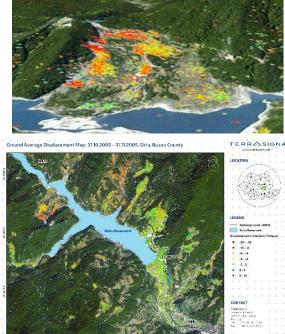
Monitoring services based on satellite and in situ data processing: natural hazards risks - landslides, Siriu area, Romania

Landslides monitoring - Siriu area
(31.10. – 11.11.2009)

Ground Average Displacement Map: 31.10.2009 – 11.11.2009, Siriu, Buzau County

Monitoring services based on satellite and in situ data processing: natural hazards risks - landslides, Siriu area, Romania
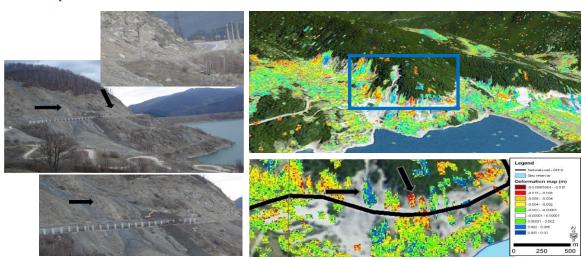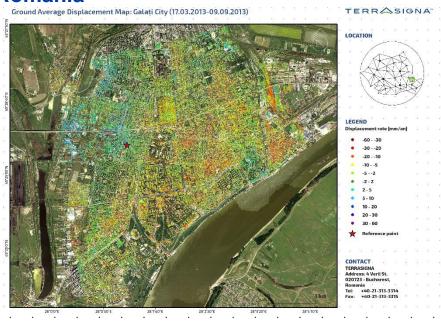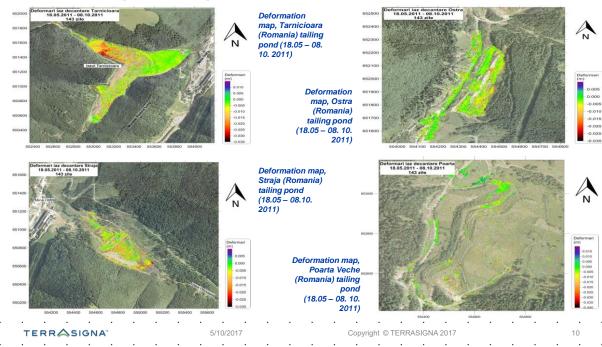

Landslide in Siriu area: left – photo, right – deformation map
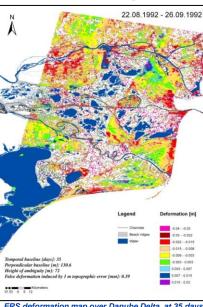
Monitoring services based on satellite and in situ data processing: natural hazards risks - landslides, Galati area, Romania

Ground Average Displacement Map: Galați City (17.03.2013-09.09.2013)

TERRASIGNA

LOCATION

LEGEND
Displacement rate [mm/an]

- -60 - -30
- -30 - -20
- -20 - -10
- -10 - -5
- -5 - -2
- -2 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 30
- 30 - 60
- ★ Reference point

CONTACT
TERRASIGNA
Address: 4 Verii St.
020723 - Bucharest,
Romania
Tel: +40-21-313-3314
Fax: +40-21-313-3315
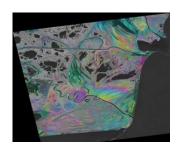
Monitoring services based on satellite and in situ data processing: mining zones (Romania)

Deformation map, Tarnicioara (Romania) tailing pond (18.05 – 08. 10. 2011)

Deformation map, Ostra (Romania) tailing pond (18.05 – 08. 10. 2011)

Deformation map, Straja (Romania) tailing pond (18.05 – 08.10. 2011)

Deformation map, Poarta Veche (Romania) tailing pond (18.05 – 08. 10. 2011)

Monitoring services based on satellite and in situ data processing: wet zone monitoring
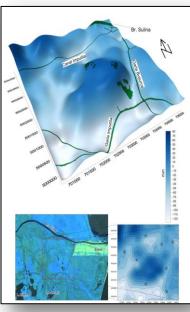
ERS deformation map over Danube Delta, at 35 days temporal baseline (22.08 – 26.09.1992)

Interferogram Alos PalSAR over Danube Delta (06.15-09.15.2009). Phase values with a color cycle represent 12 cm deformation in the line of sight of the radar.

Water level variation in Danube Delta, Sulina (June – September - 2009)
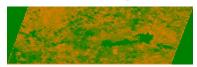
Monitoring services based on satellite and in situ data processing: wet zone monitoring

Open water occurrence in the Southern Danube Delta, as extracted from Landsat data

Monitoring services based on satellite and in situ data processing: natural hazards risks - draught

Pecica area (Romania) mask, Arad, August 13 2003
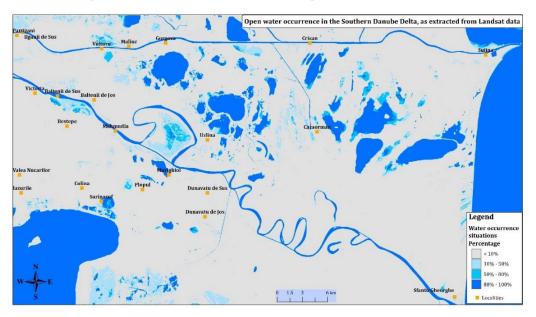
Pecica area mask (Romania), Arad, June 26 2003
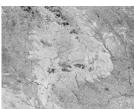
RGB processing chain

NDVI processing chain

Clouds&Shadows Mask processing chain

RGB image obtained from RAW MODIS channels, day 160, 2012, Romania – Hungary area

Final TSRM for day 160, 2012

HNDVI-RST final map for day 160, 2012

Final clouds removed maps for day 160, 2012
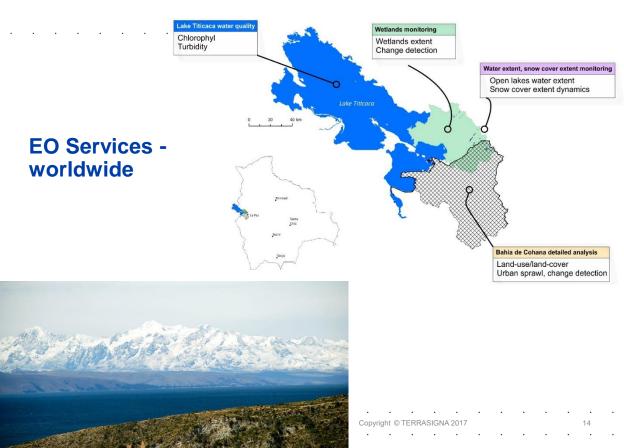
Land cover map for test zone - obtained from Pleiades image (15.07.2013)
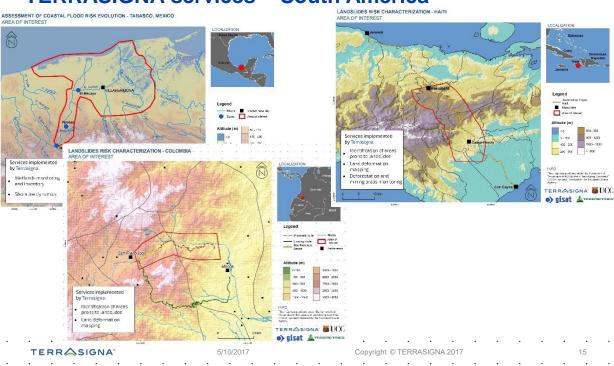
NDVI map for Romania, 7th September 2013

DROMOSIS: on-line platform - interface

EO Services - worldwide

Lake Titicaca water quality
- Chlorophyl
- Turbidity

Wetlands monitoring
- Wetlands extent
- Change detection

Water extent, snow cover extent monitoring
- Open lakes water extent
- Snow cover extent dynamics

Bahia de Cohana detailed analysis
- Land-use/land-cover
- Urban sprawl, change detection

14

TERRASIGNA services – South America

ASSESSMENT OF COASTAL FLOOD RISK EVOLUTION - TABASCO, MEXICO
AREA OF INTEREST

Services implemented by Terrasigna:
- Wetlands monitoring and inventory
- Shoreline dynamics

LANDSLIDES RISK CHARACTERIZATION - HAITI
AREA OF INTEREST

Services implemented by Terrasigna:
- Identification of areas prone to landslides
- Land deformation mapping
- Deforestation and mining areas monitoring

LANDSLIDES RISK CHARACTERIZATION - COLOMBIA
AREA OF INTEREST

Services implemented by Terrasigna:
- Identification of areas prone to landslides
- Land deformation mapping

Big Data / Data Mining

TERRASIGNA™
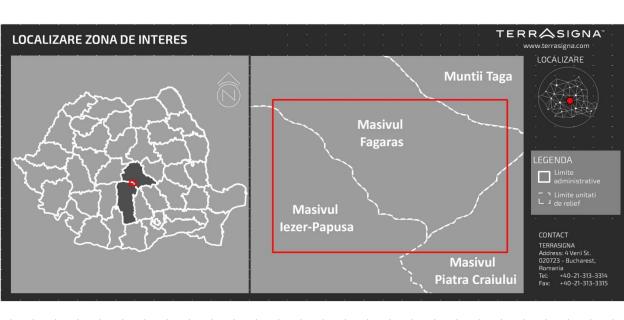
Big Data / Data Mining – Analytics Tools, SITS

△ General analytical methods for the exploitation of the information contained in Satellite Image Time Series (SITS): information extraction in the form of "categories of evolution" and elaboration of technologies to classify the evolutions processes of observed scenes

- △ Quick and effective generation of SITS
- △ Definition and categorisation of classes having the same evolution in time ("categories of evolution")
- △ Fast semantic searches of defined classes within huge image archives

Satellite Image Time Series - forestry

LOCALIZARE ZONA DE INTERES

TERRASIGNA
www.terrasigna.com

LOCALIZARE

Muntii Taga

Masivul Fagaras

Masivul Iezer-Papusa

Masivul Piatra Craiului

LEGENDA
Limite administrative
Limite unitati de relief

CONTACT
TERRASIGNA
Address: 4 Verii St.
020723 - Bucharest, Romania
Tel: +40-21-313-3314
Fax: +40-21-313-3315

Satellite Image Time Series - forestry

Evolutia suprafetei impadurite (2000 - 2014)

TERRASIGNA™
www.terrasigna.com

LOCALIZARE

LEGENDA
Suprafete de teren despadurite intre 2000 si 2014
851 ha

CONTACT
TERRASIGNA
Address: 4 Verii St.
020723 - Bucharest, Romania
Tel: +40-21-313-3314
Fax: +40-21-313-3315

LONG-TERM (1990-2015) FOREST COVER DYNAMICS ESTIMATION.
ROMANIA – CARPATHIAN MOUNTAINS

Satellite Image Time Series - Agriculture

ESTIMATIVE MISMATCH BETWEEN DECLARED AND ACTUAL CROP TYPE
ROMANIA - BARAGAN AREA - YEAR 2015

LOCALIZATION

LEGEND

strong match

poor match

■ Localities

~ Main roads

INFO
The map was created using in-house developed algorithms for content retrieval from satellite images time series. Data mining specific methodologies were employed in order to derive similar classes in terms of temporal evolution.

CONTACT
TERRASIGNA
Address: 4 Verii St.
020723 - Bucharest,
Romania
Tel: +40-21-313-3314
Fax: +40-21-313-3315

Content Based Image Retrieval - CBIR

△ Ready-to-use Open-Source platform
integrating tools for Earth Observation (EO)
Content Based Image Retrieval (CBIR)
Advanced technologies for the automatic
identification of relevant images based on
their semantic content

  △ Adapted developed technologies to EO
  image content and use, in order to exploit
  past, current and next generation of
  satellite images, taking into account the
  possibility to build long time series

  △ Implement and integrate developed
  components into an Open-Source
  platform to permit users to quickly and
  effectively exploit and extend CBIR
  functionalities
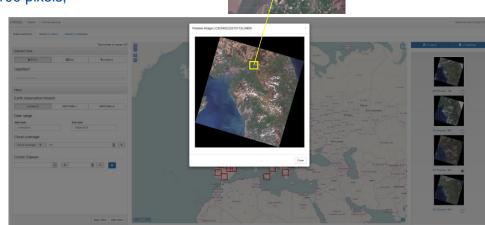
Content Based Image Retrieval - CBIR

Search in scene
Area of interest:

- the Eden River's mouth
- patch size: 100x100 pixels;

Selected scene:

- Landsat 8,
- England,
- 22 April 2015.
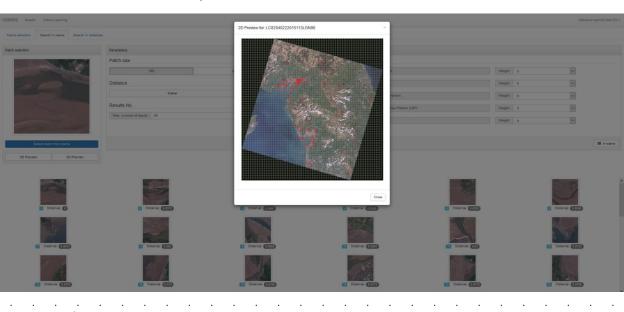
Search in scene - results

The first 18 most relevant patches in the scene

Search in scene - results

The first 50 most relevant patches in the scene
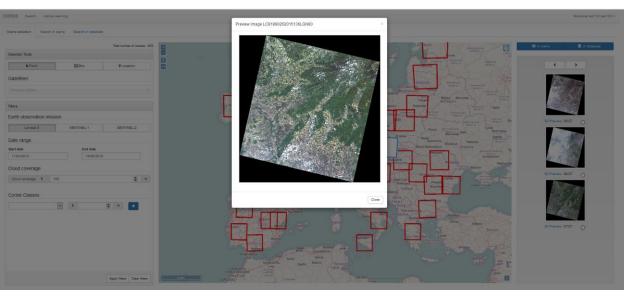
Active learning

Selected scene: Landsat 8, Bratislava, 16.05.2015
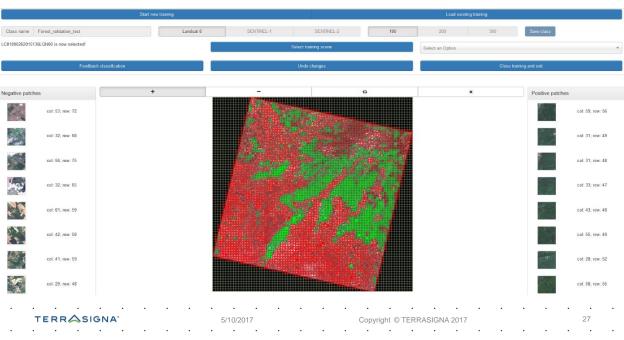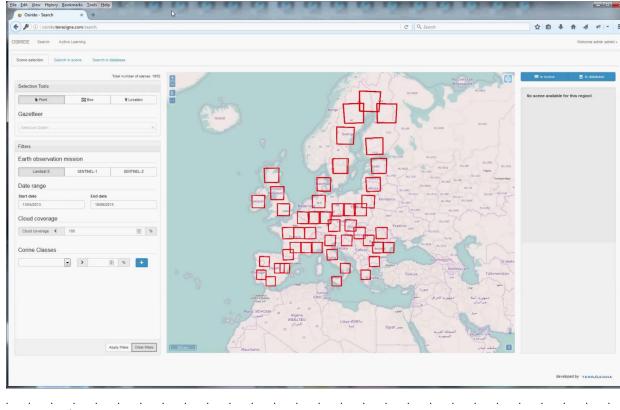
Active learning - results
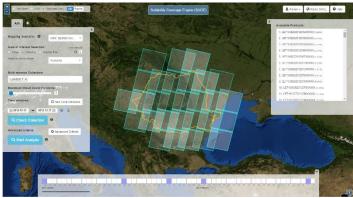
Trained class: forest (in green)

Suitability Coverage Engine (SUCE)

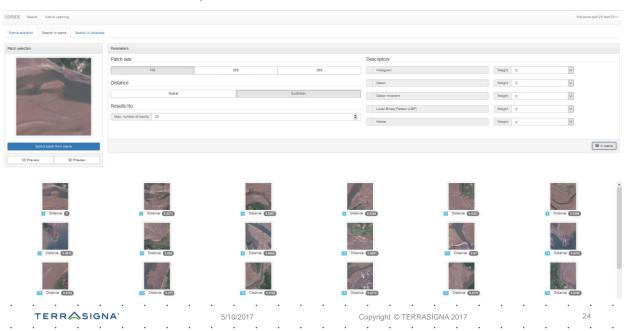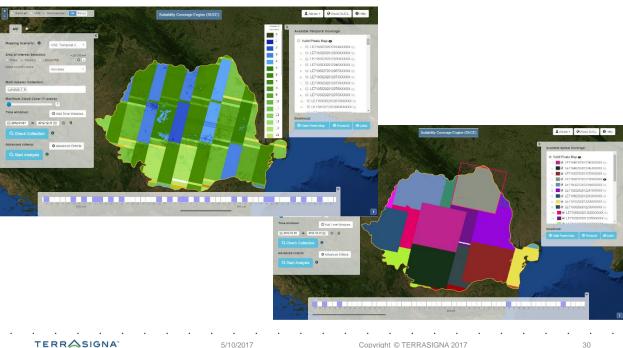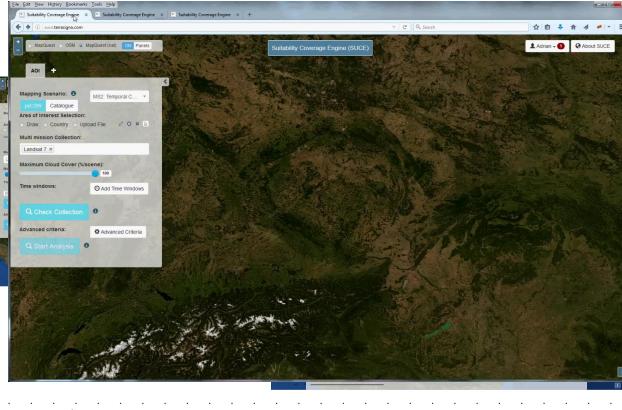△ Prototype permitting to effectively select and download EO products from identified PDGS on the basis of advanced user criteria and analytic needs.

△ It allows deriving optimal EO image product sets suitable for the defined user activities, as for instance European Copernicus mapping and monitoring tasks, avoiding both manual filtering and transfer of useless data.

Suitability Coverage Engine (SUCE)
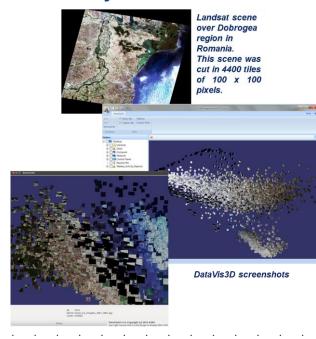
Big Data / Data Mining – Visual Analytics Tools

DataVis3D: Visual Data Mining tool aiming at interactively and efficiently browsing and understanding of the structure of large data sets of EO imaging products:
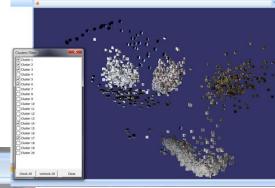
- △ The EO images are partitioned in patches (size is adapted to capture meaningful contextual information)

- △ Patches are indexed by extracting a relevant parameter set and this is represented in a descriptor (e.g. Gabor, SIFT)

- △ Multi-dimensional reduction

- △ Zoom and rotation navigation in the 3d space

Landsat scene over Dobrogea region in Romania. This scene was cut in 4400 tiles of 100 x 100 pixels.

DataVis3D screenshots
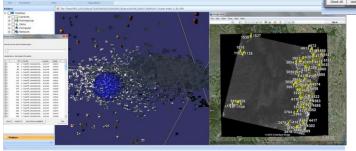
Big Data / Data Mining – Visual Analytics Tools
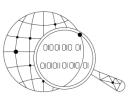
Furthermore:

△ **DataVis3D** provides
  △ a clustering approach
  △ a selection tool based on a user-defined sphere

△ Selected tiles may be projected and visualized on Google Earth

△ Selected tiles can be also annotated with their image content

DataVis3D screenshots

Desktop and Web Applications for Geospatial Data Management

TERRASIGNA™
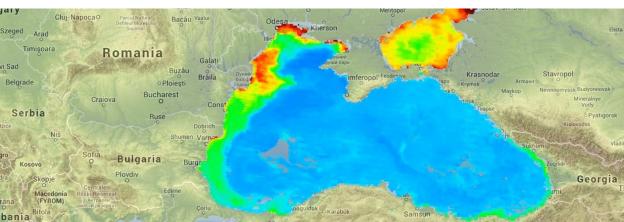
Black Sea Geoprocessing Portal - ESSPOS

http://esposs.terrasigna.com/

- Black Sea dedicated web platform for EO data access and processing
- The first online platform that gathers large amounts of information for the Black Sea area and offers to its users access to online processing and analyzing tools
- Current application areas:
  - Water pollution
  - Phytoplankton bloom
  - Sediment transport
  - Water balance
  - Ocean surface topography
- More than **70 users, from all six Black Sea neighboring countries,** consult **ESPOSS today!**

ESSPOS Products Portofolio

Layer: Sea Surface Temperature	**Layer:** Total Suspended Matter (TSM)
Map use: Representation of temperature of the water near the surface, expressed as Celsius degrees	**Map use:** Repres. of total suspended matter concentr. near the surface, expressed as mg/m3
Data source: NASA's Ocean Color Data Distribution Center	**Data source:** European Space Agency
Product level: Level 3	**Product level:** Level 2
Available period: March 2000- December 2012	**Available period:** May 2003 - December 2009
Temporal resolution: 8 day composite	**Temporal resolution:** daily
Platform and Sensor : Terra MODIS	**Platform and Sensor :** Envisat MERIS
Map scale and accuracy: 4 km spatial resolution	**Map scale and accuracy:** 1.2 km spatial resolution

Layer: Chlorophyll (CHL) concentration	**Layer:** Wind Speed
Map use: Representation of chlorophyll concentrations near the surface, expressed as mg/m3	**Map use:** Estimations of wind speeds generated using observations from multiple satellites
Data source: NASA's Ocean Color Data Distribution Center	**Data source:** National Oceanic and Atmospheric Admin.
Product level: Level 3	**Product level:** Level 4
Available period: March 2000- December 2012	**Available period:** January 2000 - February 2014
Temporal resolution: 8 day composite	**Temporal resolution:** daily
Platform and Sensor : Terra MODIS	**Platform and Sensor :** multiple sensors
Map scale and accuracy: 4 km spatial resolution	**Map scale and accuracy:** 30 km spatial resolution

Layer: Diffuse attenuation coefficient (K490)	**Layer:** Significant wave height forecast
Map use: Good indicator of water clarity and turbidity	**Map use:** Forecasts, to maximum 4 days each, at steps of 3 hours for significant wave height
Data source: NASA's Ocean Color Data Distribution Center	**Data source:** Kassandra project consortium
Product level: Level 3	**Product level:** n.a.
Available period: March 2000- December 2012	**Available period:** 19 April 2014 - present
Temporal resolution: 8 day composite	**Temporal resolution:** daily
Platform and Sensor : Terra MODIS	**Platform and Sensor :** modeled datasets
Map scale and accuracy: 4 km spatial resolution	**Map scale and accuracy:** n.a.

Layer: Chlorophyll (CHL) concentration	**Layer:** MODIS Natural Color
Map use: Representation of chlorophyll concentrations near the surface, expressed as mg/m3	**Map use:** Natural color images of the Black Sea area
Data source: European Space Agency	**Data source:** Land Atmosphere Near-Real Time Capability for EOS of NASA
Product level: Level 3	**Product level:** n.a.
Available period: January 2003- March 2012	**Available period:** 23 February 2014- Present
Temporal resolution: monthly	**Temporal resolution:** daily
Platform and Sensor : Envisat MERIS	**Platform and Sensor :** Terra MODIS
Map scale and accuracy: 9 km spatial resolution	**Map scale and accuracy:** 250 m spatial resolution

ESA C-TEP

Using the expertise in ESPOSS, TERRASIGNA is part of ESA's Coastal Thematic Exploitation Platform C-TEP to:

- provide a C-TEP interface mock up
- develop interconnection within the TEP
- develop and supply statistical libraries
- develop a pilot case on the Black Sea
- provide regional platform development and operation

EO4SEE Platform

Regional high volume data access, processing and information service delivery platforms – South Eastern Europe Region

⬦ Design and to prototype a federation of IT infrastructures (known as a regional exploitation platform for the South Eastern Europe) that would enhance usage of emerging and existing EO missions, by taking advantage of existing facilities and building a technological solution that would allow the processing of the data close to the data storage and avoid data transfer (this is vital for emerging techniques of processing such as data fusion and data mining and handling of the Sentinel satellites' large data volumes)

⬦ The IT development will be done in parallel with thematic user consultation, in order to launch a collaborative interface that would ensure the long term sustainability of the platform. Concepts like DaaS, InfaaS, SaaS, IaaS and PaaS will be used in platform implementation

EO Tablet and Smart Phones Applications

TERRASIGNA™

EO tablet and smart phones applications

EO Datasets App – allows mobile device users easy access to information provided by the Earth Online Portal and provides news on data products and also information on ESA missions.

⌂ Main user targets are both the scientific community of experienced EO users and the general public that has little experience in retrieving and using satellite data

⌂ Features:
   ⌂ Browse Data Products section
   ⌂ ESA Earth Observation Missions section
   ⌂ Data Products News section

EO Educational App - teaching people about the use and application of earth observation on global and local scale.

⌂ The application should allow the users to:
   ⌂ Visualize Biophysical parameters (e.g. air temperature, wind, etc.) on 3D globe
   ⌂ Visualize Disasters (e.g. forest fires, oil spills, etc.) on 3D globe
   ⌂ Visualize Thematic Maps (e.g. population volume, fresh water, etc.) on 3D globe
   ⌂ View multimedia content concerning the abovementioned layers
   ⌂ View theory accompanied by case studies

⌂ Target audience will be mainly teachers and students

EO tablet and smart phones applications

△ **Collaboration with NASA on the development of its new virtual globe framework, Web World Wind:** focuses on Web technologies

  △ data visualisation using virtual globe technology, by contributing to the Web World Wind framework while focusing on the mobile platform aspects

  △ demonstrators in ESA's areas of interest using the framework.

△ **Vegetation App:** promotes the Proba-V mission of the European Space Agency and gives access to users to remote sensed vegetation information

  △ *Proba-V Information* - is dedicated to the theoretical part, where all the information regarding Proba-V mission are going to be available

  △ *Camera* - allows the user to use the device camera to take a picture of the surroundings, receive vegetation information and share the image

  △ *Photo Gallery* – allows access to the photos taken with the app and their related information.

  △ *Map View* – displays the users own photos but placed via markers on a map

  △ *Community Photos (option)* – a section where the users will see other users' pictures taken with the app

EO tablet and smart phones applications

Accounting and Monitoring System (AMS) prototype for the Thematic Exploitation Platforms (TEP)

⌂System that is able to:
- ⌂gather accounting and usage data from a number of thematic platforms (TEPs)
- ⌂assemble the information
- ⌂provide intuitive means of visualisation and analysis of the data, on a per user basis

EO tablet and smart phones applications

Mobile application for land cover changes: C-LAND

⌂ C-LAND presents the dynamics of the changes occurring on European level on land cover, at different spatial and temporal scales

⌂ C-LAND addresses the need for informing citizens (non-expert users)

⌂ Provides maximum level of understanding with minimum effort from user's point of view
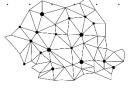
Ground Based Radar

TERRASIGNA™

Ground Based Radar

⌃Two distinct systems:
  ⌃ C/X band instrument and signal processing chain with interferometric capabilities
  ⌃ P-band terrestrial pulse compression SAR: biomass monitoring and mapping through TomoSAR and PolInSAR applications - complementary tool to spaceborne sensors

⌃General design supports **air and spaceborne operations** in the future

TERRASIGNA

△ **Romanian company having main expertise in processing, analysis and interpretation of optical and radar Earth Observation data; offers innovative solutions for environmental monitoring and risk assessment (flood risk analysis, drought early warning, deforestation evaluation etc.)**
△ **Clients: national space agencies, ESA, international financial institutions, national public authorities, private companies**
△ **Services in Romania, Europe and global scale**
△ **Member of EARSC since 2015**
△ **Member of BDVA since 2015: member of the *Board of Directors* and *Earth Observation / Geospatial Sub-group leader;* link between BDVA and EC (DG GROW) and ESA on Big Data**
△ **Five main development directions:**
   △ Monitoring services based on satellite and in situ data processing for: natural hazards risks (drought, floods, landslides / earthquakes), mining, urban and wet zones, agriculture, forestry, critical infrastructure, CO2 storage areas, marine/oceanic environment, water quality
   △ Web based applications and platforms for data searching, downloading, management and processing
   △ Big data / data mining - analytics tools and services for EO and linked data access
   △ Educational software development
   △ Complementary ground based data acquisition sensors (radar) for different monitoring applications and services
△ **Other activities:**
   △ Modeling Tool Design
   △ EO tablets and smart phones applications

Thank you for attention