



Coordinating and integrating state-of-the-art
Earth Observation Activities in the regions of
North Africa, Middle East and Balkans
and Developing Links with GEO related initiatives
toward GEOSS

GEO-CRADLE pre-Kick-Off Meeting
Friday, 18th of February, 2016

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Tel Aviv University

Highlights of EO-MINERS FP7 Projects

{Logo of Institute}

IONIC Centre, 11 Lysiou Street
Athens, Greece



EO-MINERS



European Technology Platform
on Sustainable Mineral Resources

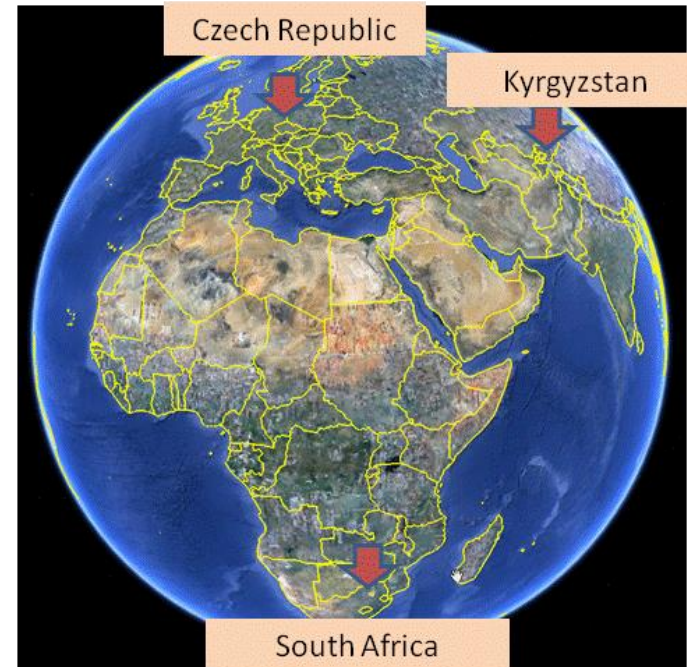


Earth Observation for Monitoring and Observing Environmental and Societal Impacts of Mineral Resources Exploration and Exploitation

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EO-Miners – FP7



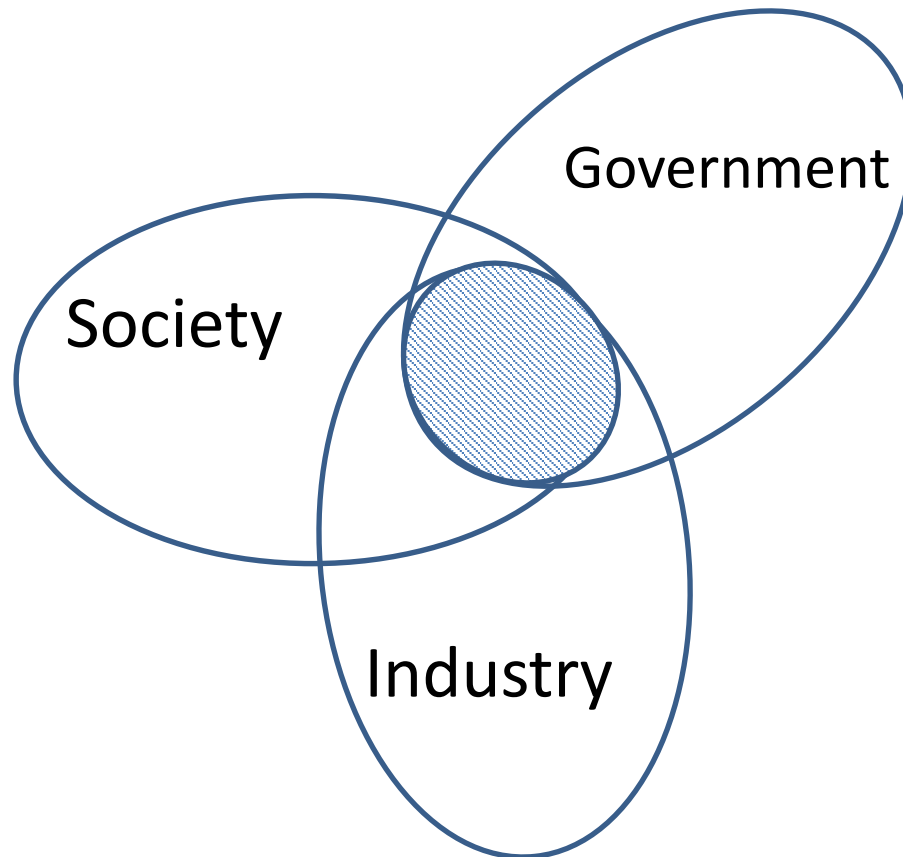
“Integrate new and existing Earth Observation tools to improve best practice in mining activities and to reduce the mining related environmental and social footprint”



The objective of this activity is to organise the EO-MINERS products so that they can form part of the Global Earth Observing System of Systems (GEOSS) being developed by the Group on Earth Observations (GEO). This will ensure that the project's outcomes form a contribution to GEO from the minerals sector, filling a strategic gap in GEO, an initiative which does not address minerals to any meaningful extent at present.

- WP1: Policy Analysis and Indicator Identification
- WP2: Protocols and standards for EO products
- WP3: EO application and development over demonstration sites
- WP4 : EO integration and products
- WP5 : Communication, dissemination, capacity building and exploitation

The EO-Miners Dialog Concept



EO Data in EO-MINERS

Sokolov

- HyMap 2009 / 2010
- CartoSat 2009, 2010, 2011
- AHS 2011 (+ AISA, partly processable)
- ASD / μ FTIR measurements, XRF measurements, samples for lab analysis, temperature measurements, dust samples

Witbank

- FLIR 2011
- WV-II 2011 (DEM existit)
- ASD measurements, temperature measurements, dust samples
- ALERT system installed at bank no.5

Karzaman

- WV-II 2011 (DEM and relief and drainage parameter exist)
- ASD measurements, GPS measurements, dust samples



EO Product Development Matrix

Cuecar	Environmental Issue	Indicators*	Measurable parameter	Potential for EO assessment of parameter	EO data availability for parameter	Task status	Comment	Investigating institute	
AMD	Water Quality	Water Quality: E4 (disturbance generated potential distribution of sulfide iron minerals)	Distribution of minerals on surface minerals	YES - Hyperspectral airborne data	Airborne hyperspectral available for '15, '18 and '19 (all tasks needed); some ASTER images may be of limited use	Several Airborne hyperspectral images are mapped	Initial Airborne hyperspectral images are being mapped. Cuecar is also reviewing work on a pH map based on mineral spectral signatures of sulfate also compare with other results from TMU/DLR?	DLR, TMU, DGS, BRGM, Cuecar GS	
			Distribution of minerals with stratigraphic exposure	YES - Hyperspectral airborne data	Airborne hyperspectral available for '15, '18 and '19 (all tasks needed); some ASTER images may be of limited use	Several Airborne hyperspectral images are mapped	Hydrologically neutral DEM needed (justification: ArcGIS), AGPS data required, use as georeferenced near the photogrammetric DEM for this.	DLR, TMU, DGS and BRGM	
			Surface drainage map	YES - SRTM, LIDAR or elevation derived from stereo aerial photography or stereo satellite images. Multi-spectral terrain model [i.e., terrain DEM] is required	S DEM derived from Cuecar stereo images of 2005, 2010 and 2011 (all tasks and normally available); There is also a photogrammetric S DEM from approx 2008 with ~3 year age range	DEM is not that they need to be refined. BRGM to discuss potential improvements with DLR?	Hydrologically neutral DEM needed (justification: ArcGIS), AGPS data required, use as georeferenced near the photogrammetric DEM for this.	BRGM is lead, will support from Cuecar GS, DLR DGS	
			Proportion of fluid within aquifer	YES - ground truth required to measure water table (surface regional water table GRACE satellite data could be utilized), but only if ground truth model is available	No available data available [HP]	Hydrographic information exist	Difficult to model. Is there a ground water model available? If not, we probably have to build the flow measurement device this.	This remains to be done as we do not have 3D geological data	
			Topographic maps	YES - SRTM, LIDAR or elevation derived from stereo aerial photography or stereo satellite images	S DEM derived from Cuecar stereo images and some ASTER imagery. We also have '18 and '25 and/or topographic map data and VK indicates that the IPR will allow us to use them.	Task for Cuecar GS; Cuecar DEM may be useful once validated. '15, '18, '25, '26 maps as FTP	Cuecar GS		
			Biogeochemical data	YES - Hyperspectral airborne data, if the potential data are near areas can be distinguished from background levels	Airborne hyperspectral available for '15, '18 and '19 (all tasks needed). Slide and pie chart the answer	Final samples have been collected by	Cuecar GS are working on correlation between PM10 ground mass	Cuecar GS and TMU	
Wildfires and dust, aerosol emissions	Atmospheric pollution	Air quality, and air mass measurements. D4 (erosion potential neutral in off-site air)	Atmospheric aerosols	YES - Hyperspectral airborne data, if the potential data are of available size / concentration and the concentration of near areas can be distinguished from background levels	Airborne hyperspectral available for '15, '18 and '19 (all tasks needed)	no information	Task for Cuecar GS; Cuecar DEM may be useful once validated. '15, '18, '25, '26 maps as FTP	?	
			Infrared vegetation stress map	YES - Hyperspectral airborne data	Airborne hyperspectral available for '15, '18 and '19 (all tasks needed)	Cuecar GS is working on re-validation links	Vegetation stress induced by air pollution is most likely to affect vegetation near urban areas and further from water workings. Cuecar GS have developed a model for vegetation forests	Cuecar GS	
AMD and Mining	Lead degradation/trace	Lead Mass - B1 (Total lead ore by mining and milling (topographic footprint); B4 Residential lead ore (residential developments around mining areas); B6 Site and waste, potential areas for lead resources, outcrops, sites of potential value and similar); B8 Resettlement measures on mineral areas and waste disposal (waste (resettled mining areas assessed by specific regulations); B10 Soil fertility of resettled mine areas	Soil lead mass [i.e., color resonance, sulfides, ferrous, etc]	YES - Hyperspectral airborne data, ASTER, Landsat or other optical imagery	Airborne hyperspectral available for '15, '18 and '19 (all tasks needed). Landsat, AVHRR-2 and some ASTER imagery	no information (in re-validation work from VK) possibly false green	Cuecar is mapping but no information from this data exist	Cuecar GS, BRGM, DLR?	
			Isolated areas map	YES - Very high resolution optical imagery, color imagery	No available data available [HP]	Updated GIS data provided by Cuecar GS	Cuecar is working on re-validation links	Re-define work working on original work, CORINE data?	BRGM & DLR
			Reclassification sources	YES - Time-series analysis of Landsat and/or SPOT imagery for lead 3B zones, and airborne hyperspectral imagery for mineral status	Landsat time-series can be acquired from archive	Cuecar GS is working on re-validation links	Change derivation analysis of acquisition classifications or mineral interpretation	?	
			Vegetation stress map	YES - Hyperspectral airborne data	Airborne hyperspectral available for '15, '18 and '19 (all tasks needed); ASTER or Landsat (to be used)	Cuecar GS is working on re-validation links	Vegetation stress induced by air pollution is most likely to affect vegetation near urban areas and water workings. Cuecar GS have developed a model for vegetation forests	Cuecar GS	
			Topographic maps	YES - SRTM, LIDAR or elevation derived from stereo aerial photography or stereo satellite images	S DEM derived from Cuecar stereo images and some ASTER imagery. We also have '18 and '25 and/or topographic map data and VK indicates that the IPR will allow us to use them.	only re-validation information available (right); this may not be available for use	Task for Cuecar GS; Cuecar DEM may be useful once validated. '15, '18, '25, '26 maps as FTP	Cuecar GS	
			Topographic maps	YES - SRTM, LIDAR or elevation derived from stereo aerial photography or stereo satellite images	S DEM derived from Cuecar stereo images and some ASTER imagery. We also have '18 and '25 and/or topographic map data and VK indicates that the IPR will allow us to use them.	Task for Cuecar GS; Cuecar DEM may be useful once validated. '15, '18, '25, '26 maps as FTP	Cuecar GS		
			Digital terrain model	YES - SRTM, LIDAR or elevation derived from stereo aerial photography or stereo satellite images. Multi-spectral terrain model [i.e., terrain DEM] is required	S DEM derived from Cuecar stereo images of 2005, 2010 and 2011 (all tasks and normally available) and some ASTER imagery. There is also a photogrammetric S DEM from approx 2008 with ~3 year age range	DEM re-validation (2005, 2010, 2011, 2014) DEM re-validation/dating	DEM re-validation/dating. BRGM to discuss potential improvements with DLR	BRGM & DLR	
Overburden instability	Landslide	Geotechnical Assessment and monitoring. G5 (stability index calculation in re-validation data)	Slope map	YES - SRTM, LIDAR or elevation derived from stereo aerial photography or stereo satellite images. Digital terrain model [i.e., terrain DEM] is required	S DEM derived from Cuecar stereo images and some ASTER imagery. We also have '18 and '25 and/or topographic map data and VK indicates that the IPR will allow us to use them.	See areas above with re-validation measurements	Our known area with measured monitoring data is current source of this problem. Need of original. Slope map can be derived in parallel with DTM and drainage map	BRGM/DLR?	
			Water control	YES - Airborne hyperspectral data; Chris-Pook & SMO5 satellite data provide the spatial detail	Airborne hyperspectral available for '15, '18 and '19 (all tasks needed)	will monitor measurements for our area - monitoring data. However [re-validation conditions]. Possible mapping ahead?	?		
Self-healing of faults	Coal fires	Hot use of the identified indicators as re-validation. Coal fires and issues in re-validation of this area	Temperature	YES - Thermal imagery, airborne and satellite	Day and night thermal hyperspectral imagery available (only night data is available) and some ASTER thermal imagery	some thermal anomalies (hot spots) have been identified	Hot spots identified but may be too small as they are very localized; further investigations using MS data are programmed	DLR?	
			Gas emission	YES - Hyperspectral airborne data, ASTER or Hyperspectral	Airborne hyperspectral available for '15, '18 and '19 (all tasks needed); Landsat and some ASTER imagery may be of limited use	no re-validation data available	Hot spots too small for re-validation work	DLR?	
Potential hydrologic fracturing of pressurized aquifer underlying the JE site	Thermal spring geofluid	Hot use of the identified indicators as re-validation. Significant Picrochlorine change	Heat measurements	YES - Thermal airborne and satellite data and thermal springs, borehole heat measurements requires in situ measurements	Day and night thermal hyperspectral imagery available (only night data is available) and some ASTER thermal imagery. In situ measurements are not HP	no information	Regional approach	?	
			Water table	YES - Ground truth required	No available data	no information	Is there a ground water model available?	?	
Dewatering	Groundwater discharge	Hot use of the identified indicators as re-validation. This Water table	Ground level	YES - InSAR, GPS, multi-temporal LIDAR	No available data available yet	agree pilot work	No data available	?	
			Surface drainage map	YES - SRTM, LIDAR or elevation derived from stereo aerial photography or stereo satellite images. Digital terrain model [i.e., terrain DEM] is required	S DEM derived from Cuecar stereo images of 2005, 2010 and 2011 (all tasks and normally available) and some ASTER imagery. There is also a photogrammetric S DEM from approx 2008 with ~3 year age range	DEM is not that they need to be refined. BRGM to discuss potential improvements with DLR?	Hydrologically neutral DEM needed (justification: ArcGIS), AGPS data required, use as georeferenced near the photogrammetric DEM for this	BRGM is lead, will support from Cuecar GS, DLR DGS	
Underground mining	Stibnite	Hot use of the identified indicators as re-validation. This Stibnite	Water instability	YES - Aerial photography, very high resolution imagery [i.e., WV-H] and hyperspectral airborne imagery	Airborne hyperspectral available for '15, '18 and '19 (all tasks needed); Landsat and some ASTER imagery may be of limited use	no information	No observations for the local observation	?	
			Topographic maps	YES - SRTM, LIDAR or elevation derived from stereo aerial photography or stereo satellite images	S DEM derived from Cuecar stereo images of 2005, 2010 and 2011 (all tasks and normally available) and some ASTER imagery. There is also a photogrammetric S DEM from approx 2008 with ~3 year age range	Task for Cuecar GS; Cuecar DEM may be useful once validated. '15, '18, '25, '26 maps as FTP	Cuecar GS		
			Cost-minimized water	YES - Aerial photography, very high resolution imagery [i.e., WV-H] and hyperspectral airborne imagery	Airborne hyperspectral available, airborne hyperspectral imagery available for '15, '18 and '19 (all tasks needed)	no information	Locations will be from previous field campaigns used as training areas	BRGM	
			Slope map	YES - SRTM, LIDAR or elevation derived from stereo aerial photography or stereo satellite images. Digital terrain model [i.e., terrain DEM] is required	S DEM derived from Cuecar stereo images of 2005, 2010 and 2011 (all tasks and normally available) and some ASTER imagery. There is also a photogrammetric S DEM from approx 2008 with ~3 year age range	no information	Can be derived from DEM?	DGS	

Grouped by Indicator



EO Product Development Matrix

Environmental issues	Indicators	Measurable parameters	Potential for EO assessment of parameters	EO data availability for parameters	Task /status	Comments	Scale	Data Layer	Investigating institute
Water quality & soil properties	Water Quality: E4 Acid drainage generation potential (distribution of sulphidic iron minerals)	Distribution of secondary iron oxide minerals	YES – Hyperspectral airborne data	Airborne hyperspectral available for '09,'10 and '11 (although cloudy); some ASTER imagery may be of limited use	Selected AMD-related minerals can be mapped. CzechGS used ASTER for mineral mapping(?)	Czech GS are finishing pH map based on mineral/coal composition - compare with other results from TAU/DLR?	Local	image/grid or vector layer of iron oxide minerals	DLR, TAU, BGS, BRGM & Czech GS
		Distribution of minerals with neutralisation capacity	YES – Hyperspectral airborne data	Airborne hyperspectral available for '09,'10 and '11 (although cloudy); some ASTER imagery may be of limited use	Selected minerals/soils can be mapped. CzechGS used ASTER for mineral mapping(?)	Selected soils and minerals can be mapped. Map scale?	Local	image/grid or vector layer of neutralising minerals	DLR, TAU, BGS, BRGM & Czech GS
		Surface drainage map	YES – SRTM, LiDAR DEM from stereo aerial photography or satellite imagery. Note: digital terrain model is required	5 m DEMs derived from Cartosat stereo images of 2009, 2010 and 2011 (not currently suitable). There is also a photogrammetric 5m DEM from approx 2008 with a 3 year age range	DEMs exist but they need to be edited. BRGM to discuss potential improvements with DLR?	Hydrologically correct DEM and/or dGPS data required; can potentially use photogrammetric DEM. GIS stream network exists => drainage map of mining area risk?	?	surface draining map - Strahler order streams, vector map	BRGM to lead, with support from Czech GS, DLR & BGS
		Relief maps	YES – SRTM, LiDAR orDEM derived from stereo aerial photography or satellite imagery	5 m DEMs derived from Cartosat stereo images and some ASTER imagery. We also have 10k and 25k vector topographic map data and VK indicates that the IPR will allow us to use them		Task for Czech GS; Cartosat DEM may be useful once validated. 1:10,000-scale maps on FTP	?	DEM, displayed as shaded relief base map (raster format)	Czech GS & BGS

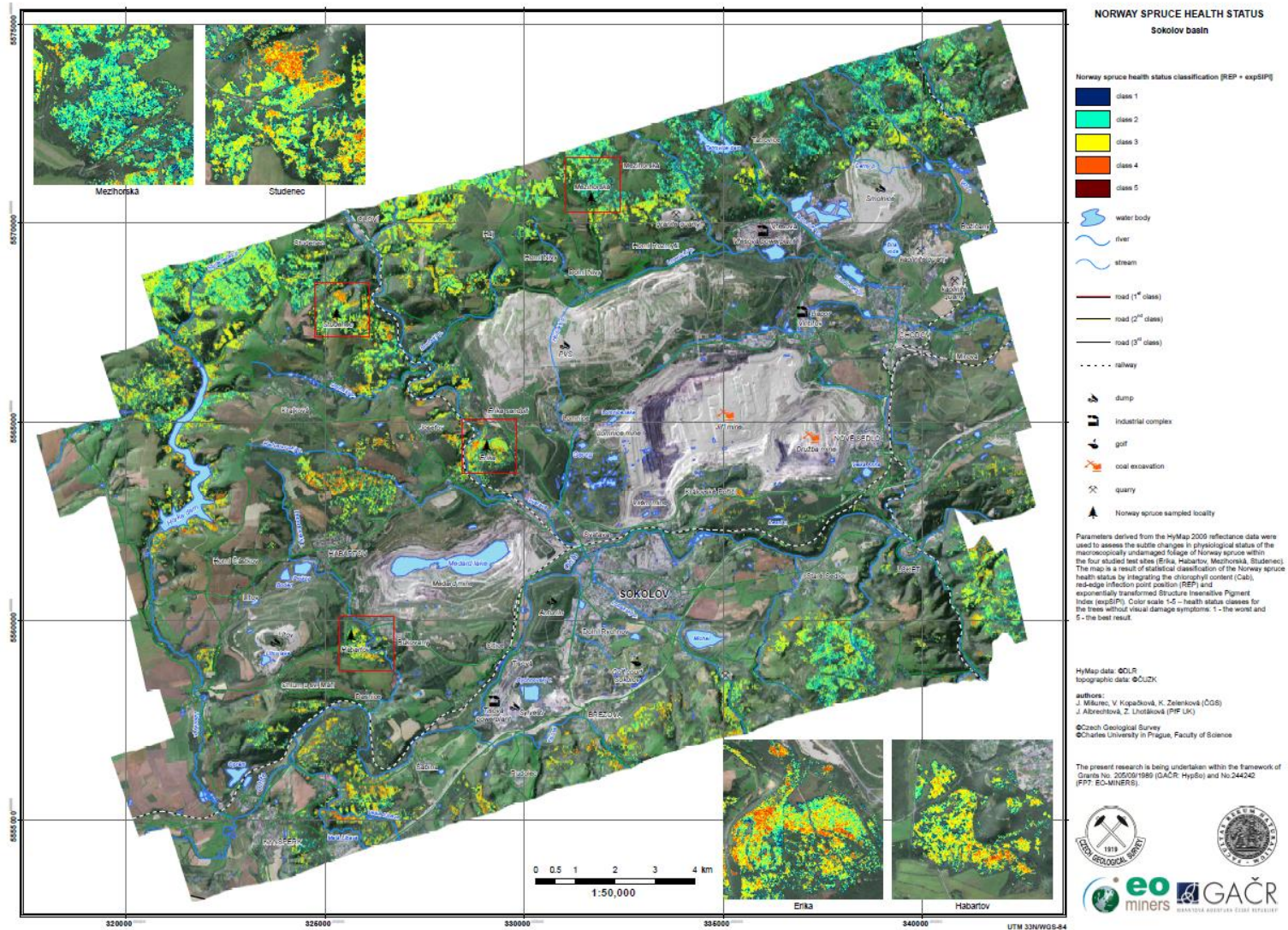
WP2 deliverables

- **D1.8** – “Status quo of monitoring environmental indicators by EO services” was submitted
- **D2.1** – “EO Mission Planning for Environmental Monitoring of Mining Impact
- **D2.2** – “Data Inspection”.
- **D2.3** “Atmospheric calibration and validation”
- **D2.4** – “Thematic accuracy and validation
- **D2.5** - Documentation and dissemination

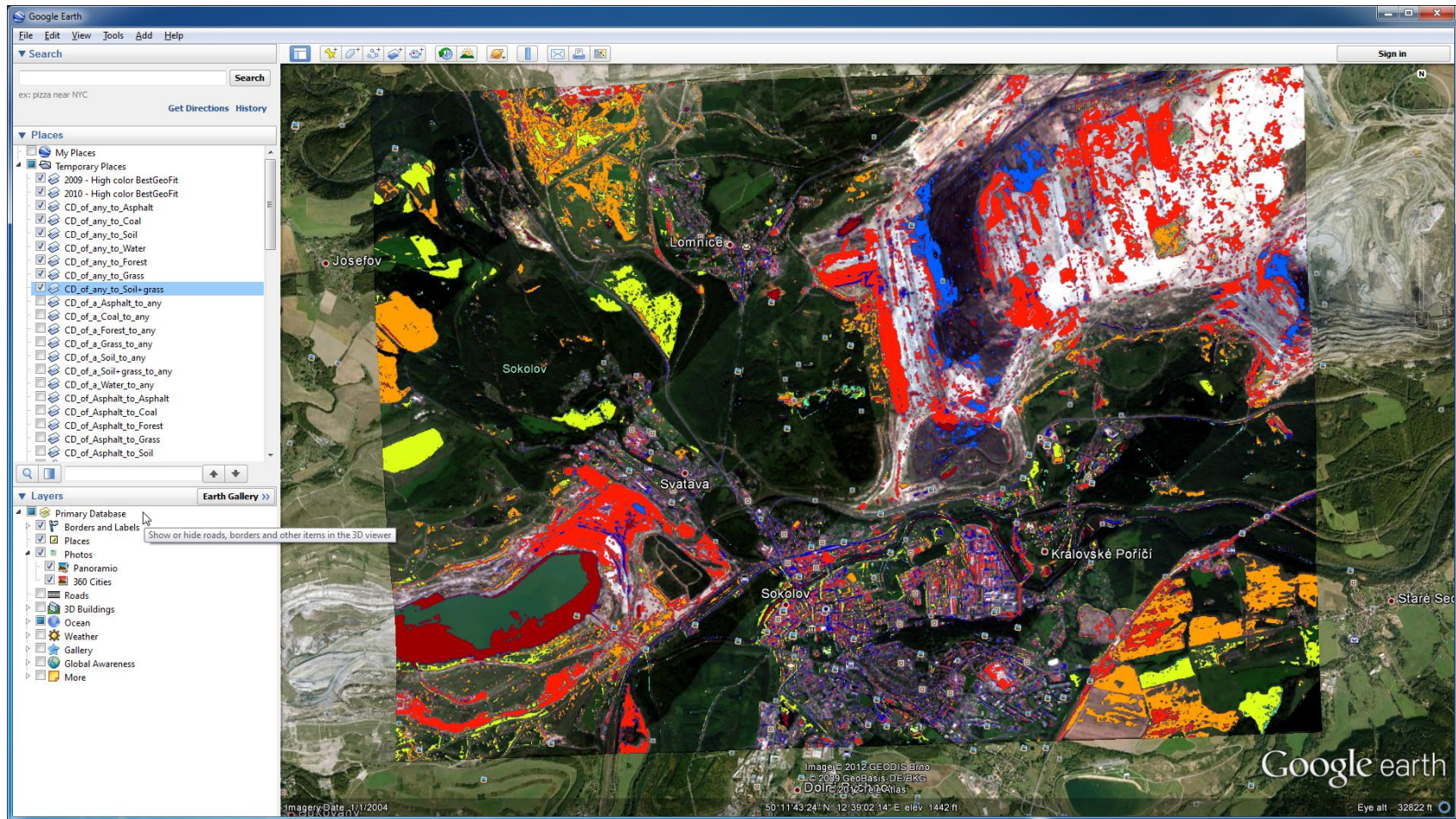
Related GEOSS Strategic Targets

- User Engagement: **Increased use of geo-spatial data** in all Societal Benefit Areas and in particular in developing countries.
- Health: **Access to improved environmental information and tools** to support the global community of human health and environment experts. Applying outcomes from other Societal Benefit Areas to improve health and well-being.
- Energy: **Significant increase in use of Earth observations by all sectors** (biomass, fossils, geothermal, hydropower, nuclear, ocean, solar and wind) **for improved environmental, economic and societal impact assessments of energy exploration, extraction**, conversion, transportation and consumption.
- Water: **Increased availability of data and information, including quantity and quality of both surface and groundwater**, to support a water cycle decision making system.
- Ecosystems: **Increased operational monitoring of major ecosystems** on land on an annual basis. Increased operational monitoring of major marine and coastal ecosystems on an annual basis.

EO Product Sample (map)



Change Detection – Using SOT method for extracted significant spectral change Sokolov 2009-2010



(Google Earth as an easy interface for thematic map presentation)

Main achievements of WP2 in EO-Miners (standards and protocols)

- ASD spectrometer operation and documentation (TAU)
- Field spectra processing workflow
- Geo-rectifying – work flow and inspection (TAU)
- Radiometric inspection and atmospheric correction (TAU, DLR)
- Sampling of vegetation using SPAD Chlorophyll meter
- Estimating the Noise Level in the radiance domain
- Standards and Protocols for Reflectance Measurement of Soils in the Laboratory
- Dust wipe sampling
- Dust site selection
- Street dust sampling procedure
- Street dust chemical analytical procedure
- Field database documentation in excel (BRGM)
- ALERT system installation
- Field work documentation protocol
- Emissivity measurement protocol

EO-Miners WP- 2

- WP2 is focused on **standards and protocols** for EO projects.
- A large number of EO working protocols were collected and developed during the project period.
- The output of WP2 is 5 deliverables that can be used in future projects as standard working protocols

Main achievements of WP2 in EO-Miners

(General)

- Mapping indicators to EO tools
- Mission planning protocol
- Geo-rectification protocol
- Geo-rectification quality indicators
- Field spectral measurements protocol
- HRS atmospheric correction protocol
- HRS atmospheric correction quality indicators
- HRS atmospheric correction comparison
- New HRS change detection approach (two articles in review)
- Thermal atmospheric correction protocol
- Emissivity field measurement protocol
- Thermal clay/ sand mapping
- Apparent thermal inertia mapping
- WV-2 iron oxides mineral mapping
- New digital field archiving tool (CSIRO has requested a copy)
- Spectral prediction of dust components
- Reflectance measurement of soils in the laboratory protocol



USAID

NIFA

EUFAR -1

EUFAR-2

EO-MINERS

