Impact assessment of human activities, the EO-MINERS showcase

EO contribution in monitoring environmental and societal impact of mining Activities

Stephane CHEVREL
General context

- Securing EC raw material supply
- ETP – SMR and Strategic Research Agenda
- GMES: integrating spaceborne and subsurface information component, EU Raw Material Initiative
- GEO - GEOSS
International initiatives and raw materials

• **EU**
  - EU’s 2001 Sustainable Development Strategy (SDS) (renewed in 2006)
  - 2005 Thematic Strategy for the Sustainable Use of Natural Resources
  - 2008 EGS proposals for the implementation of a coherent EU non-energy raw materials policy
  - Flagship initiative "Resource Efficient Europe"
  - European Innovation Partnership (EIP) on raw materials
  - Africa-EU High Level Conference on Raw Materials

• **International**
  - ICMM Sustainable Development Framework
  - SDMI, an international forum for the Sustainable Development indicators in the Mineral Industry
  - African Mining Vision 2050
  - African Mining Partnership (AMP)
The aim of EO-MINERS is to bring into play EO-based methods and tools to facilitate and improve interaction between the mineral extractive industry and the society in view of its sustainable development while improving its societal acceptability.
OBJECTIVES - 1

Assess **policy requirements** at macro (public) and micro (mining companies) levels

- Theme of indicators
  a. Land Use
  b. Mass flows
  c. Energy Flows
  d. Air related
  e. Water related
  f. Transport
  g. Geotechnical
  h. Accidents
  i. Social impacts
  j. Regional development
  k. Economic vulnerability

Define environmental, socio-economic, societal and sustainable development criteria and **indicators** to be possibly dealt using EO
Demonstrate the capabilities of integrated EO-based methods and tools in:

- monitoring,
- managing
- contributing to reduce the environmental and societal footprints of all phases of a mining project

Mineral Mapping Sokolov (CZ)
Contribute making reliable and objective information about affected ecosystems, populations and societies, basis for a sound “trialogue” between industrialists, regulatory bodies and stakeholders.
EO-MINERS Consortium

3 demonstration sites (CZ, ZA, KG)
Who we are?

<table>
<thead>
<tr>
<th>Beneficiary name</th>
<th>Country</th>
<th>Beneficiary name</th>
<th>Country</th>
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</thead>
<tbody>
<tr>
<td>(BRGM) Bureau de Recherches Géologiques et Minières</td>
<td>France Coordination</td>
<td>Council for Geoscience</td>
<td>South Africa</td>
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<tr>
<td>British Geological Survey</td>
<td>UK</td>
<td>Anglo Operations Limited, Anglo Technical Division</td>
<td>South Africa</td>
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<td>Tel-Aviv University</td>
<td>Israel</td>
<td>Université de Versailles – St Quentin</td>
<td>France</td>
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<tr>
<td>Deutsches Zentrum für Luft - und Raumfahrt e.V.</td>
<td>Germany</td>
<td>Česká Geologická Služba</td>
<td>Czech Republic</td>
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<td>Wuppertal Institut für Klima, Umwelt, Energie GmbH</td>
<td>Germany</td>
<td>Sokolovská Uhelná a.s.</td>
<td>Czech Republic</td>
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<tr>
<td>Geoloski Zavod Slovenije</td>
<td>Slovenia</td>
<td>Central Asian Institute for Applied Geoscience</td>
<td>Kyrgyzstan</td>
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<td>Mineral Industry Research Organisation</td>
<td>UK</td>
<td>KyrgyzAltyn</td>
<td>Kyrgyzstan</td>
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EO and GIS in societal acceptability – a simplified conceptual model
EO and GIS in societal acceptability – a simplified conceptual model

- Project Tn
- Environment
- Environmental and societal impacts
- Societal acceptability
- Populations
- Affected Populations
- Affected Environment
- Pathways
- Transfer media

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Sokolov lignite open pit demo site (CZ)

- AMD (Acid Mine Drainage)
- Impact on vegetation
- Coal fires
- Sediment (coal) Dust
- Landscape degradation
Emalahleni (Witbank) coal field demo site (South Africa)

- The largest coal field in ZA
  - More than 60 x 60 km
- AMD (Acid Mine Drainage) affecting
  - Drainage system and wetlands
  - Urban areas
- Coal fires
- Dust
- Subsidence
- Landvalue degradation
- Uncontrolled urban sprawling
EO-MINERS Makmal – Kazarman gold mine demo site (KG)

- Cyanide contamination
  - Surface waters
  - Groundwater?
- Radioactive contamination
- Health
- Employement 70% depending on mine activity
EO tools and methods

• **Satellite data**
  – Conventional optical sensors: Landsat Thematic Mapper, ASTER
  – Very high resolution optical sensors, such as Ikonos, Quickbird, WorldView_II, SPOT 5
  – Radar sensors, in particular for INSAR applications

• **Airborne data**
  – Airborne imaging spectroscopy (hyperspectral) survey
  – Airborne geophysics: radiometric, electromagnetic, aeromagnetic
  – Thermal infrared (multi and broad band)

• **In situ monitoring methods**
  – Time-lapse electrical resistivity tomography (ALERT)
  – Ground monitoring networks
  – In situ point measurements (temperature, pH, ...)
  – Field spectroradiometry campaigns (VNIR, SWIR, TIR)
  – Information and/or measurements about vegetation, soil, groundwater and dust
  – Chemical Model and 3D characterization of the contaminated soils
• Securing the inclusion of minerals in GEO work plan 2012 – 2015 (with AEGOS)

• Two SBAs now address minerals
  – EN-01: Energy and Geo-resources Management
  – SB-05: Impact Assessment of Human Activities
EO-MINERS contribution to GEO 2012 – 2015 work plan management

• SB-05 three components:
  – Component C2: Impact Monitoring Systems for Geo-resource Exploration and Exploitation
    • EC FP7 (EO-MINERS, ImpactMin), BRGM (France, s.chevrel@brgm.fr), DLR (Germany), BGS (UK)

• EN-01
  – Component C1: Tools and Information for the Resource Assessment, Monitoring and Forecasting of Energy Sources (including solar, wind, ocean, hydropower, and biomass) and Geological Resources (including mineral and fossil resources, raw material and groundwater)
    • EC FP7 (EO-MINERS), Mines ParisTech (thierry.ranchin@ensmp.fr), DLR (Germany), BGS (UK)
      CEOS, EuroGeoSurveys, IEEE, IRENA, IUGS
WP 2012 – 2015
EN-01-C1 priority actions

• Develop and promote the use of integrated Earth observations for each stage of the mineral lifecycle (exploration, extraction, transportation, waste disposal, mine remediation and aftercare) to provide the basis for informed decision-making and improved geo-resources management. Develop a sustainable “trialogue” between the mining industry, regulators and civil society.

• Encourage training of decision-makers at all relevant levels for interpreting relevant data and products.
WP 2012 – 2015
SB-05- C2 priority actions

• Develop new tools for impact monitoring of mining operations using Earth observations

• Integrate information from in-situ, airborne and satellite observation (through data assimilation) to provide impact diagnostics

• Identify and implement strategic measures for the competitive, reliable and sustainable management of geo-resources exploitation and treatment of re-usable materials, based on innovative monitoring and accounting methodologies (see also EN-01)

• Integrate often-sectoral monitoring approaches (and corresponding impact analysis) into a coherent approach, based on innovative Earth observation techniques (related to space-borne, airborne and ground-based sensor systems)
Integrate spaceborne, airborne and ground-based EO datasets into mature stakeholder-oriented EO products.

- Integrated EO-based products and tools to monitor the societal and environmental impact of the extractive industry over all phases of a project, from exploration to closure.
SB-05-C2 progress and key outputs for 2012

- better addressing minerals within GEO
- towards services in mineral exploration, impact assessment, closure and reclamation
SB-05-C2 progress and key outputs for 2012

- Indicators for assessing and monitoring environmental and societal impact of extractive industry
- Proceedings of GEO and Minerals workshop
- Qal/val for hyperspectral data acquisition and processing
- Mineral and vegetation mapping from VNIR – SWIR – TIR imaging spectroscopy
- Starting on-site triologue (industry, regulators, local communities) activities
Mining-related indicator development strategy

WP2

Expert elucidation

Indicator A
... Indicator X

Technology assessment

Feasibility evaluation

Technology Development

Indicator A
Indicator C
Indicator G

Technology testing

Merge indicators

Indicator C
Indicator 7
Indicator λ

WP1, WP5

Stakeholder elucidation

Indicator 1
... Indicator n

Feasibility evaluation

Indicator 2
Indicator 7
Indicator 9

WP3

Conceptual Site model

Indicator α
... Indicator μ

Feasibility evaluation

Indicator α
... Indicator λ

Exploitation of TIR imaging spectroscopy

- Lake Medard (CZ) former open pit
- Enhancement of geotechnical engineered banks and trails for site rehabilitation

Quartz : yellow
Clay rich : blue
Exploitation of SWIR imaging spectroscopy

- Mapping areas of high acidity in lignite mine area
key impediments and gaps

• Lack of spaceborne high resolution hyperspectral sensors
  - rely on airborne on-demand data acquisition at high cost
  - local scale assessments

• Reluctance of industrialists to provide, share and disseminate data on impact of their activity
Linkage with other GEO Tasks

Energy and Geo-Resources Management
- Information for resource assessment
- Integrated EO for each cycle of mineral life
- Participative approach

Building Interoperability
- Infrastructure
- Institutions & Development
- Societal Benefits

M&I Working Group and Evaluation Teams

GEO Plenary

Infrastructure Implementation Board
- Task Coordinators
- Task Teams

Institutions & Development Implementation Board
- Task Coordinators
- Task Teams

Societal Benefits Implementation Board
- Task Coordinators
- Task Teams

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Spectral measurements

- Field measurements - reflectance and emissivity QA (*new protocol + standards*)
Sokolov: spectral measurements
VNIR - SWIR

Generation of dedicated spectral libraries for ASTER and hyperspectral image calibration and processing

Red Spectrum – Image reflectance spectra; Blue Dashed Spectrum – ASD ground truth spectra
• Evolution of mining and urbanisation along time
• Employement and urbanisation strongly dependant on mining
"Trialogue" approach

EO-MINERS Trialogue

European Trialogue
- MFA Workshop
- GMES / RMI
- SDIMI (??)

Site-specific Trialogues
- One individual workshop per test site
- Workshop in South Africa
- Workshop in Czech Republic
- Workshop in Kyrgyzstan

Raise awareness about possible contribution of EO methods and EO-MINERS products to impact assessment, influence related policy developments

Get stakeholders to talk to each other about impact assessment and suitable (joint) actions
Recommandations for accelerating WP implementation

• Lobbying industry community and associations (EuroMines, ETP-SMR…) for a better engagement in participative actions
  – Involve industry and industrialists in GEO – GEOSS (role of GEO Sec?)
• Promote EO-based integrated tools in user oriented conferences and events (rather than in EO oriented events…) = tackling the right audience
Thanks for your attention!

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