EO-MINERS

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

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Mining INDABA 2011
Workshop on environmental, socio-economic and sustainable development criteria and indicators in the mining sector
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
Other international initiatives

- **European Union**
  - 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

- **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)
Mining vs. society

Sustainable Supply Mix

Scope of Concern

Discovery and Access

PRE-HISTORY
1800's
Early 1900's
Late 1900's
2000+
FUTURE

Time

Equity
Community
Environment
Workers
Markets and Capital
The "policy cycle"

Identification of objectives and interests

Definition of policy

Codification of policy in laws and acts

Establishment of a regulatory framework

Review and adaptation

Monitoring

After Solar and Shields, 2011
Revising policies to adapt to changing societal goals

- Identification of objectives and interests
- Definition of policy
- Codification of policy in laws and acts
- Establishment of a regulatory framework
- Monitoring
- Review and adaptation

After Solar and Shields, 2011
Information for sustainable mineral policy & management

Identification of objectives and interests

Definition of policy

Codification of policy in laws and acts

Establishment of a regulatory framework

Review and adaptation

monitoring

After Solar and Shields, 2011
The economic pillar

• Providing a proper long term economic environment for exploration and mining activities to ensure minerals supply.

• Safeguarding mineral deposits through land use planning to secure future minerals supply promoting research and development for resources and energy efficiency.

After Solar and Shields, 2011
The environmental pillar

• Ensuring that the negative environmental impacts of the extractive industry are controlled to acceptable levels of risk.

• Promoting sound site reclamation and aftercare practices.

• Promoting research and development, e.g. environmentally sound mining methods (cradle to grave), materials efficiency, substitution, recycling and use of Best Available Techniques (BAT).

After Solar and Shields, 2011
The social pillar

- Promoting the essential contribution of minerals in society, including mine heritage.
- Promoting a transparency for government, authorities, industry, NGOs and the general public (from local to national) to avoid conflicts and support sound and timely decision making.
- Promoting academic education and training, and health and safety.

After Solar and Shields, 2011
**EO-MINERS scientific objectives**

<table>
<thead>
<tr>
<th>Assess <strong>policy requirements</strong> at macro (public) and micro (mining companies) levels and <strong>define environmental, socio-economic, societal and sustainable development criteria</strong> and <strong>indicators</strong> to be possibly <strong>dealt using EO</strong></th>
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<tr>
<td><strong>Use and develop EO on demonstration sites</strong> to demonstrate the capabilities of <strong>integrated EO-based methods and tools</strong> in:</td>
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<tr>
<td>• monitoring,</td>
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<td>• managing</td>
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<td>• contributing reducing the environmental and societal footprints of all phases of a mining project</td>
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<td><strong>Contribute making reliable and objective information</strong> about affected ecosystems, populations and societies, basis for a sound “<strong>trialogue</strong>” between industrialists, governmental organisations and stakeholders</td>
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3 demonstration sites (CZ, ZA, KG)
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<tr>
<th>Beneficiary name</th>
<th>Country</th>
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</tr>
</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>
</tr>
<tr>
<td>British Geological Survey</td>
<td>UK</td>
<td>Anglo Operations Limited, Anglo Technical Division</td>
<td>South Africa</td>
</tr>
<tr>
<td>Tel-Aviv University</td>
<td>Israel</td>
<td>Université de Versailles – St Quentin</td>
<td>France</td>
</tr>
<tr>
<td>Deutsches Zentrum für Luft- und Raumfahrt e.V.</td>
<td>Germany</td>
<td>Česká Geologická Služba</td>
<td>Czech Republic</td>
</tr>
<tr>
<td>Wuppertal Institut für Klima, Umwelt, Energie GmbH</td>
<td>Germany</td>
<td>Sokolovská Uhelná a.s.</td>
<td>Czech Republic</td>
</tr>
<tr>
<td>Geoloski Zavod Slovenije</td>
<td>Slovenia</td>
<td>Central Asian Institute for Applied Geoscience</td>
<td>Kyrgyzstan</td>
</tr>
<tr>
<td>Mineral Industry Research Organisation</td>
<td>UK</td>
<td>KyrgyzAltyn</td>
<td>Kyrgyzstan</td>
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Earth Observation

- Earth observation is the gathering of information about planet Earth’s physical, chemical and biological systems (Wikipedia)
- Earth observations can include:
  - a birdwatcher’s notes on bird sightings
  - numerical measurements taken by a thermometer, wind gauge, ocean buoy, altimeter or seismometer
  - photos and radar or sonar images taken from ground or ocean-based instruments
  - photos and radar images taken from remote-sensing satellites or aircrafts
  - decision-support tools based on processed information, such as maps and models
EO-MINERS Sokolov demo site (CZ)
EO-MINERS Emalahleni (Witbank) coal field demo site (South Africa)
EO-MINERS Makmal – Kazarman demo site (KG)
EO and GIS in societal acceptability – a simplified conceptual model
Project Tn

Pathways
Transfer media

Environment

Environmental and societal impacts

Affected Populations

Societal acceptability

Populations
EO tools and methods

- **Satellite data**
  - Conventional optical sensors: Landsat Thematic Mapper, ASTER, Hyperion, etc.
  - Very high resolution optical sensors, such as Ikonos, Quickbird, SPOT 5, etc.
  - Radar sensors, in particular for INSAR applications

- **Airborne data**
  - Airborne imaging spectroscopy (hyperspectral) survey
  - Airborne geophysics: radiometric, electromagnetic, aeromagnetic

- **In situ monitoring methods**
  - Time-lapse electrical resistivity tomography (ALERT)
  - Ground monitoring networks
  - In situ point measurements
  - Field spectroradiometry campaigns
  - Information and/or measurements about vegetation, soil, groundwater and dust
  - Chemical Model and 3D characterization of the contaminated soils
The development of meaningful indicators is a social and not an engineering process

The social process defines what to indicate for whom and why

They have to evaluate, whether a proposed indicator can be related to quantities measurable by EO

Therefore, the development of indicators is a process iterating between stakeholder expectation and operational feasibility
Indicator development strategy

A two-pronged, iterative approach is proposed:
- heuristisch development by expert elucidation
- deliberative approach to structure stakeholder input

The two processes, the expert driven and the deliberative one will run in parallel.

Once the two sets of indicators amenable to EO have been derived, they will be analysed for their respective coverage and an attempt at merging them into one set will be undertaken.

This merged set of indicators, together with results from EO services based on them will be subject to stakeholder evaluation.
Defining information requirements by stakeholders

Workshop(s)

Interview series

INDABA workshop

International EU National Regional/Local

Review of policies (desktop research)

Coverage:
- Public bodies
- Civil society
- Corporations
Stakeholder derived indicators

Themes covered by information requirements of local/regional stakeholders
Expert derived indicators

• 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
• Land use
  – Total land use by mining and milling
  – Mining land use intensity
  – Residential land use area
  – Informal settlements
  – Protected areas, site assets
  – Recultivated areas
  – Areas indirectly affected and its potential use
  – Soil fertility of remediated areas
Expert derived indicators (2)

• Mass flows
  – Generated waste volume
  – Erosion

• Energy flows
  – Total energy consumption per ton of coal / lignite /ore produced
  – EROI (Energy Return on Energy Investment)
Expert derived indicators (3)

• Air quality
  – Aerosols
  – Volatiles
  – Air related health impacts
  – Air related soil degradation
• **Water quality**
  – Hydrological balance
  – Process waters and contaminated surface run-off/stormwater
  – Aqueous contaminant releases
  – AMD potential
  – Seepage from engineered structures
    Drinking/irrigation water availability
Expert derived indicators (5)

- Transports
  - Road / rail freight volumes from/to the operation
  - Land fragmentation by transport infrastructure
  - Local air, noise and accident impacts from transport
  - Transport infrastructure quality
  - Accessibility
Expert derived indicators (6)

• **Geotechnical hazards**
  – Grade of slopes
  – Ground stability
  – Dam stability
  – Underground fires
  – Flooding risk

• **Industrial accidents**
  – Accidents in mining milling operation
  – Accidents in the operation environment
Expert derived indicators (7)

- Social impact
  - Number of created jobs
  - Job security (long term)
  - Contribution to regional income
  - Education provided
  - Health-care and welfare infrastructure provided by mining companies
Expert derived indicators (8)

- **Regional development**
  - Mandatory contributions (e.g. tax paid)
  - Voluntary contributions to the community
  - Infrastructure development

- **Economic vulnerability**
  - Risk for the community
  - Corporate vulnerability
  - Vulnerability management cost
  - Damage costs
  - Sustainability management plan
Merci de votre attention
Thank you for your attention