EO-MINERS

European Technology Platform on Sustainable Mineral Resources

COOPERATION

GROUP ON EARTH OBSERVATIONS

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

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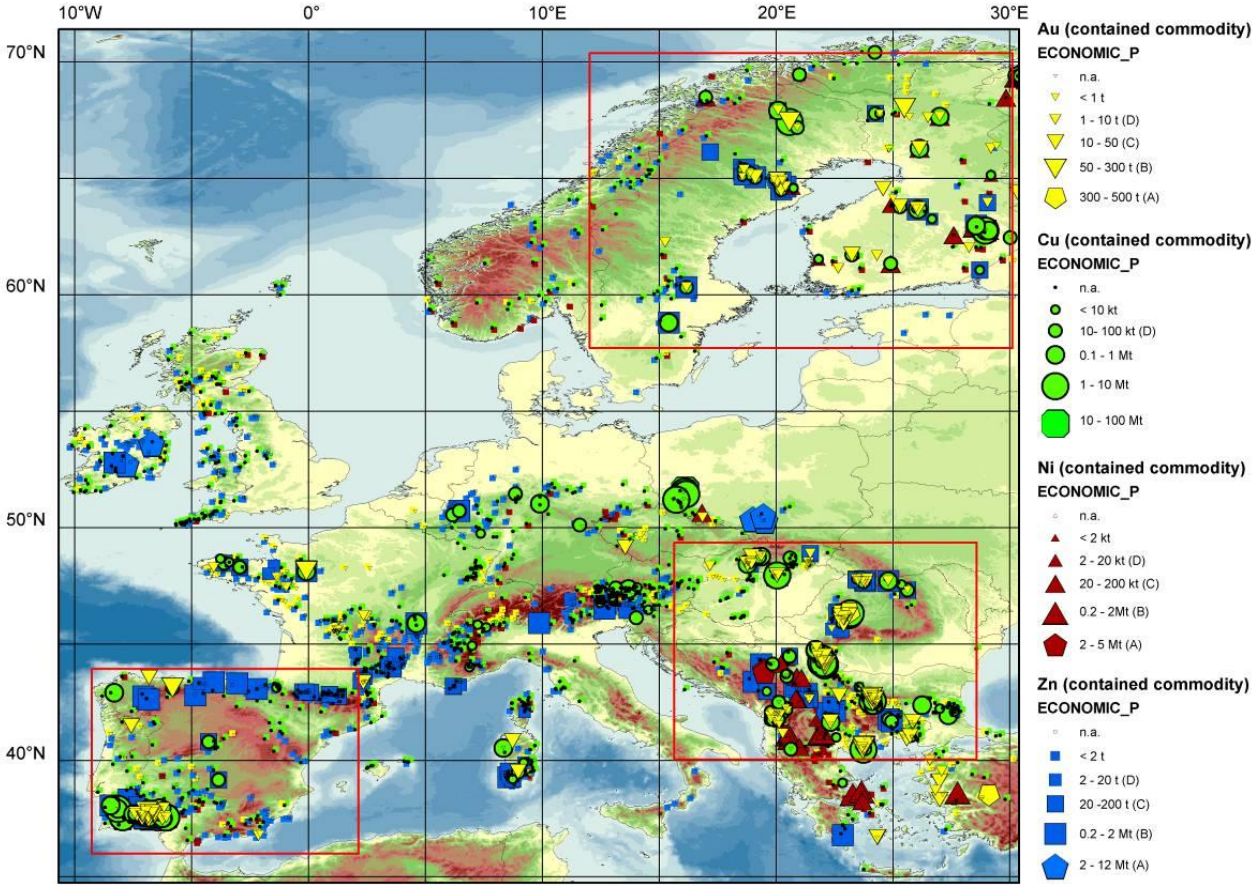
ImpactMin international workshop
Lulea, November 27, 2012

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

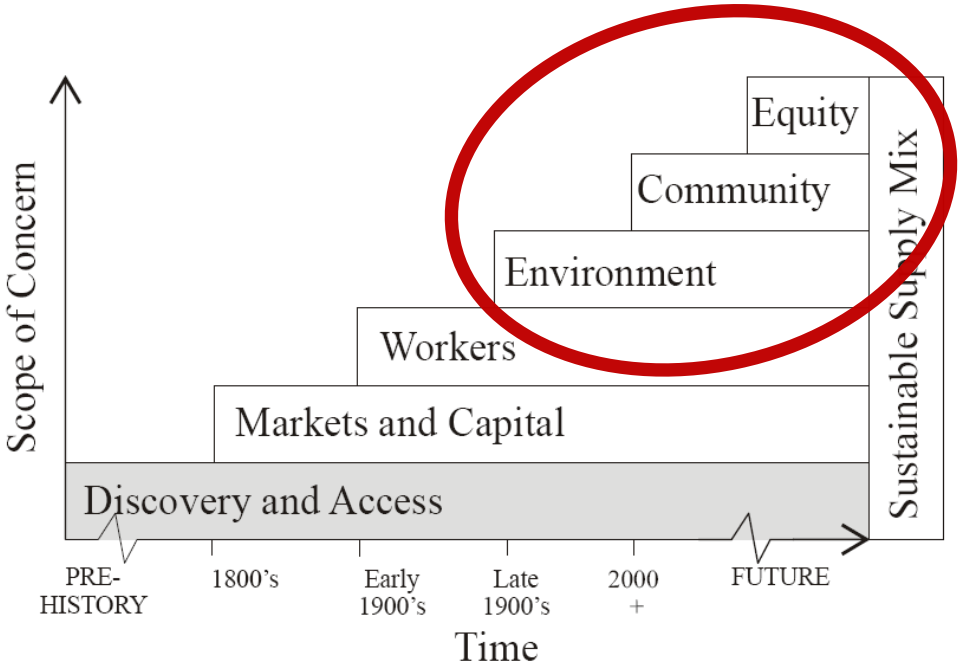


General context: International initiatives and raw materials

- **EU**
  - The Raw Materials Initiative – Meeting our Critical Needs for Growth and Jobs in Europe" (COM(2008)699)
  - 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)

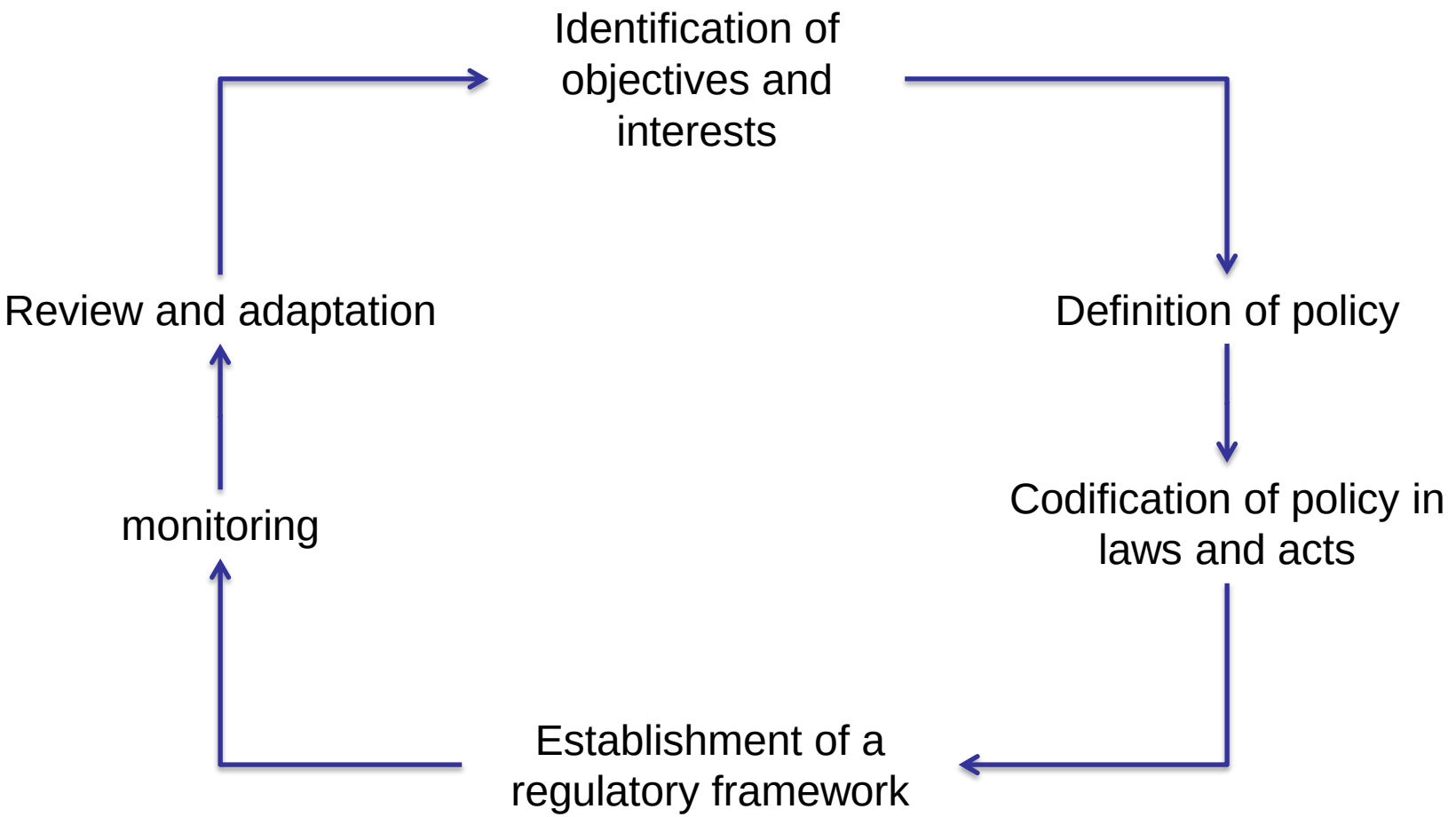
OVERALL OBJECTIVE

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.**



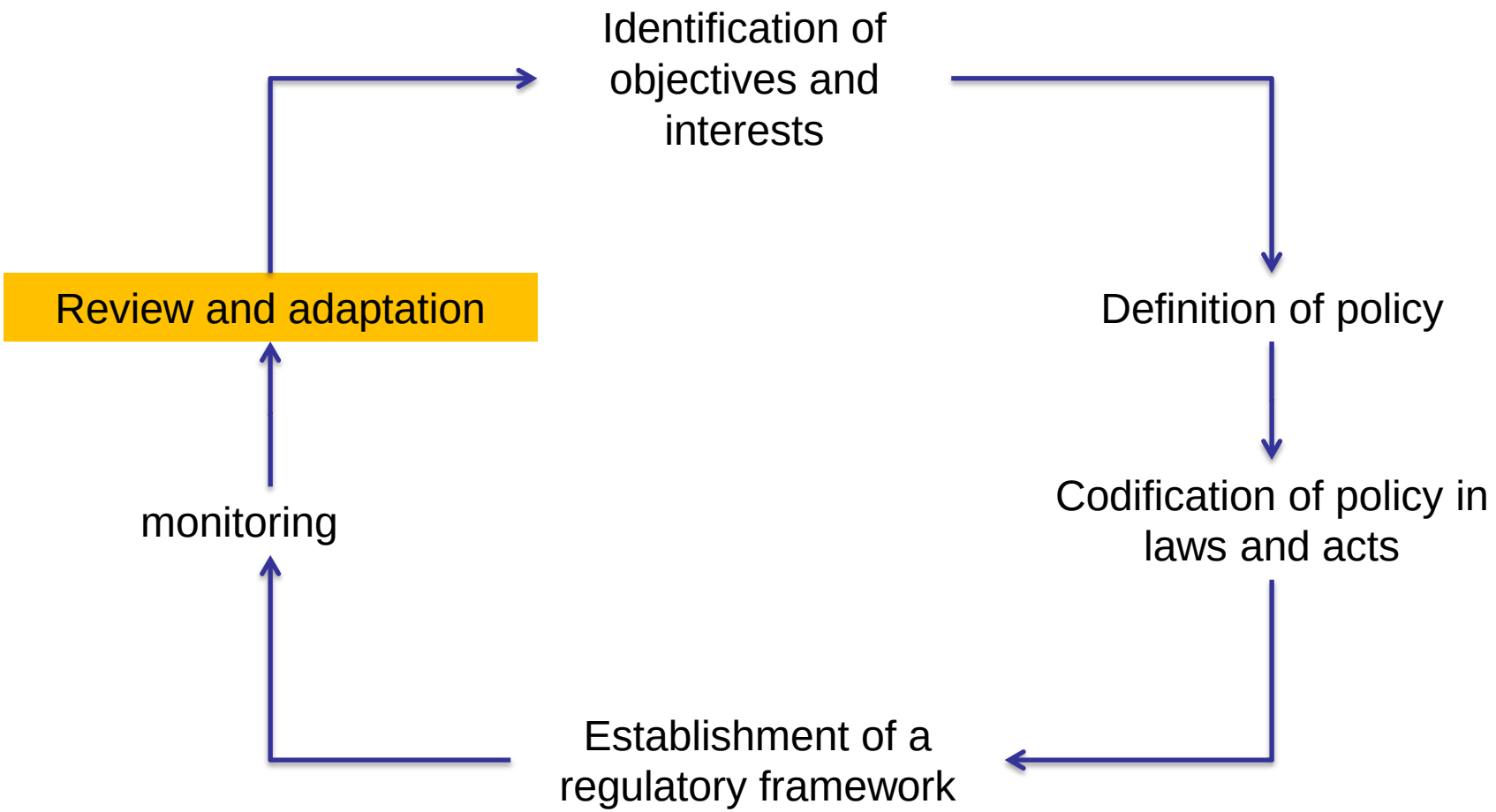
Mining vs Society

The "policy cycle"



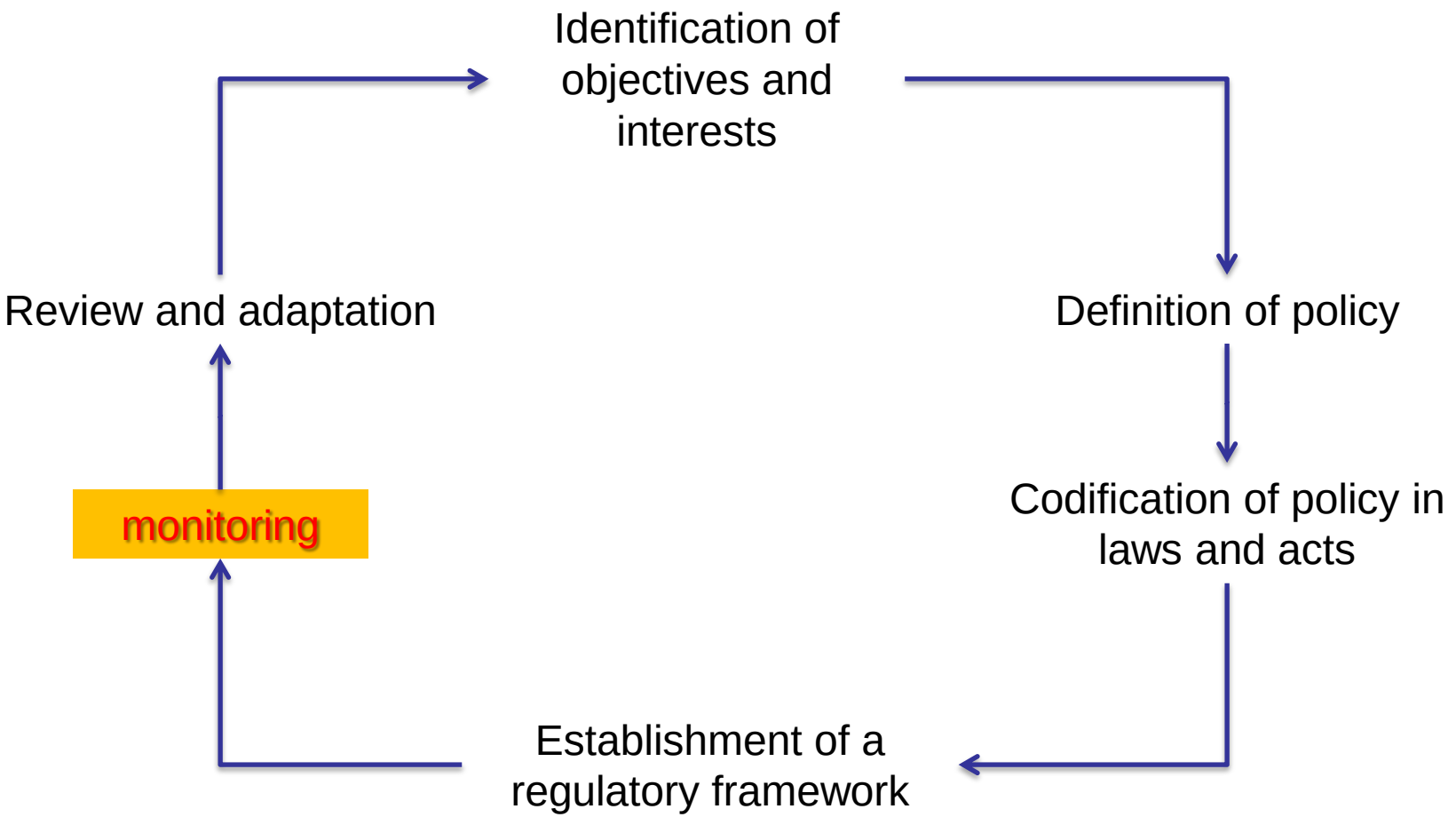
After Solar and Shields, 2011

Revising policies to adapt to changing societal goals



After Solar and Shields, 2011

Information for sustainable mineral policy & management



After Solar and Shields, 2011

Scientific objectives

Assess **policy requirements** at macro (public) and micro (mining companies) levels and **define environmental, socio-economic, societal and sustainable development criteria** and **indicators** to be possibly **dealt using EO**

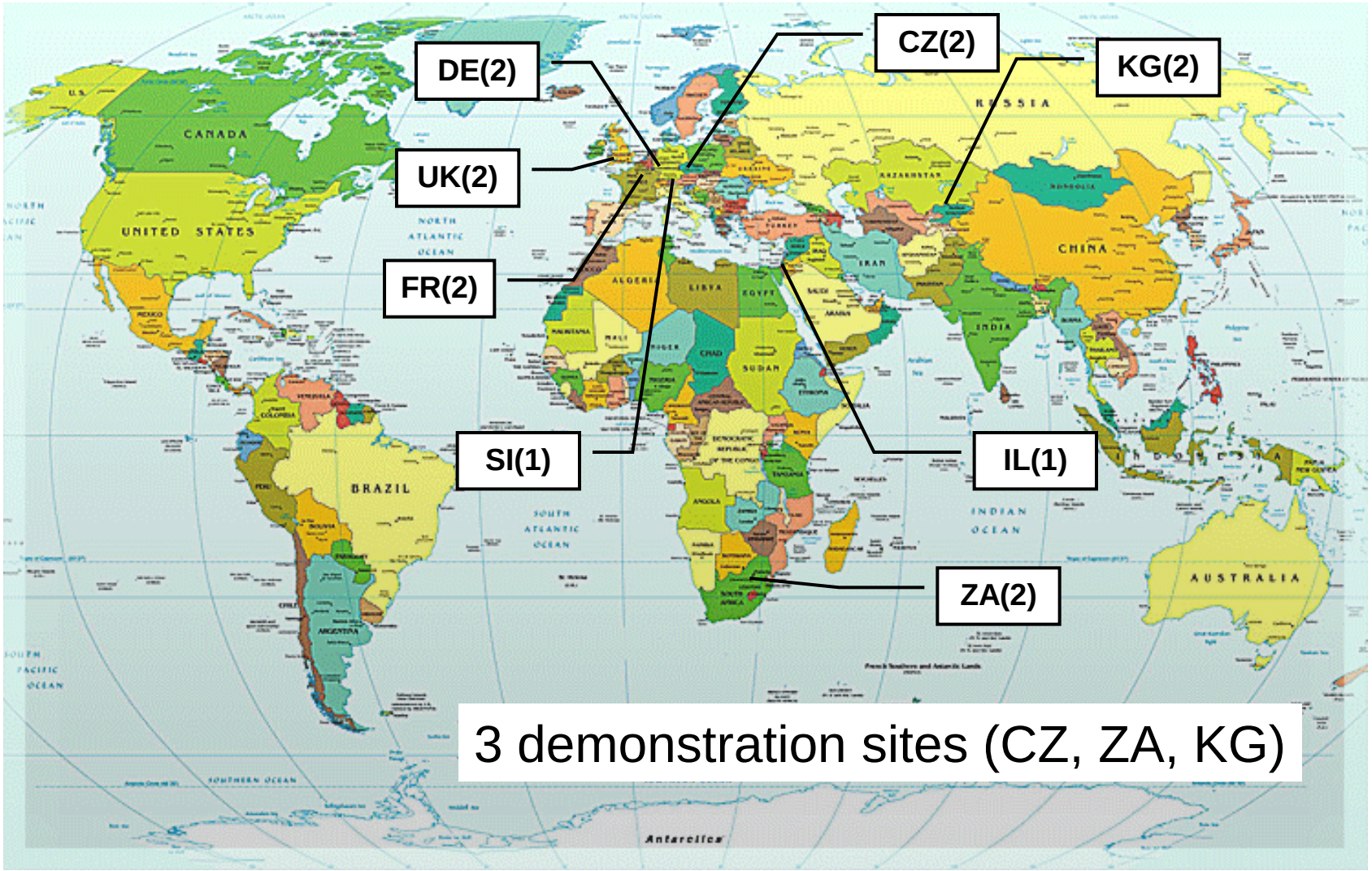
demonstrate the capabilities of **integrated EO-based methods and tools** in:

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

Contribute making **reliable and objective information** about affected ecosystems, populations and societies, basis for a sound **"trialogue"** between industrialists, governmental organisations and stakeholders

WP1 → WP2, WP3 → WP4, WP5

EO-MINERS Consortium

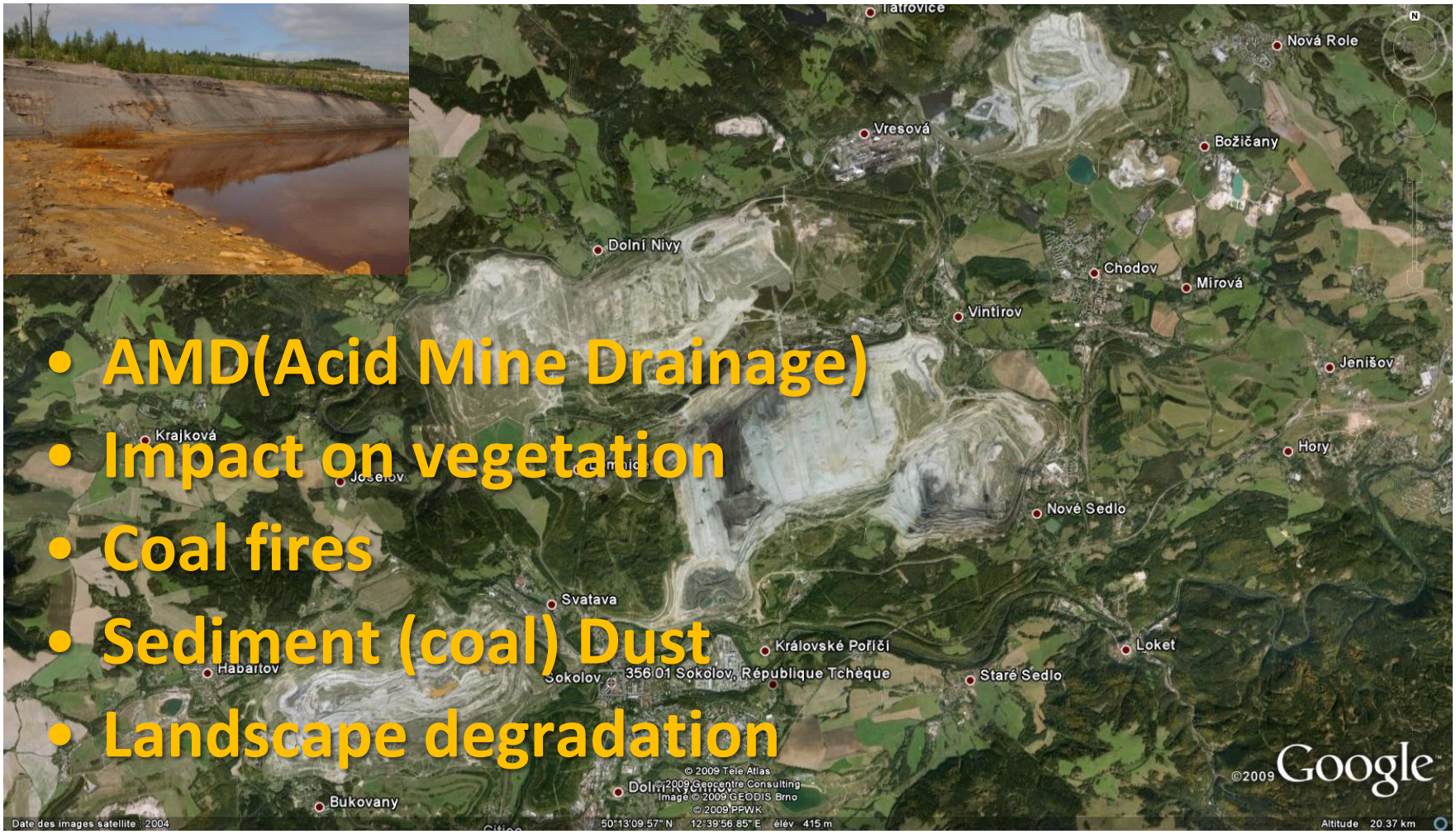


3 demonstration sites (CZ, ZA, KG)

Who we are?

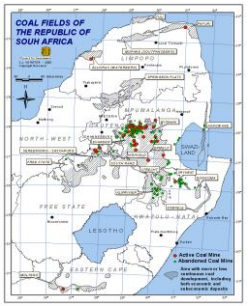
Beneficiary name	Country	Beneficiary name	Country
(BRGM) Bureau de Recherches Géologiques et Minières	France Coordination	Council for Geoscience	South Africa
British Geological Survey	UK	Anglo Operations Limited, Anglo Technical Division	South Africa
Tel-Aviv University	Israel	Université de Versailles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

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)

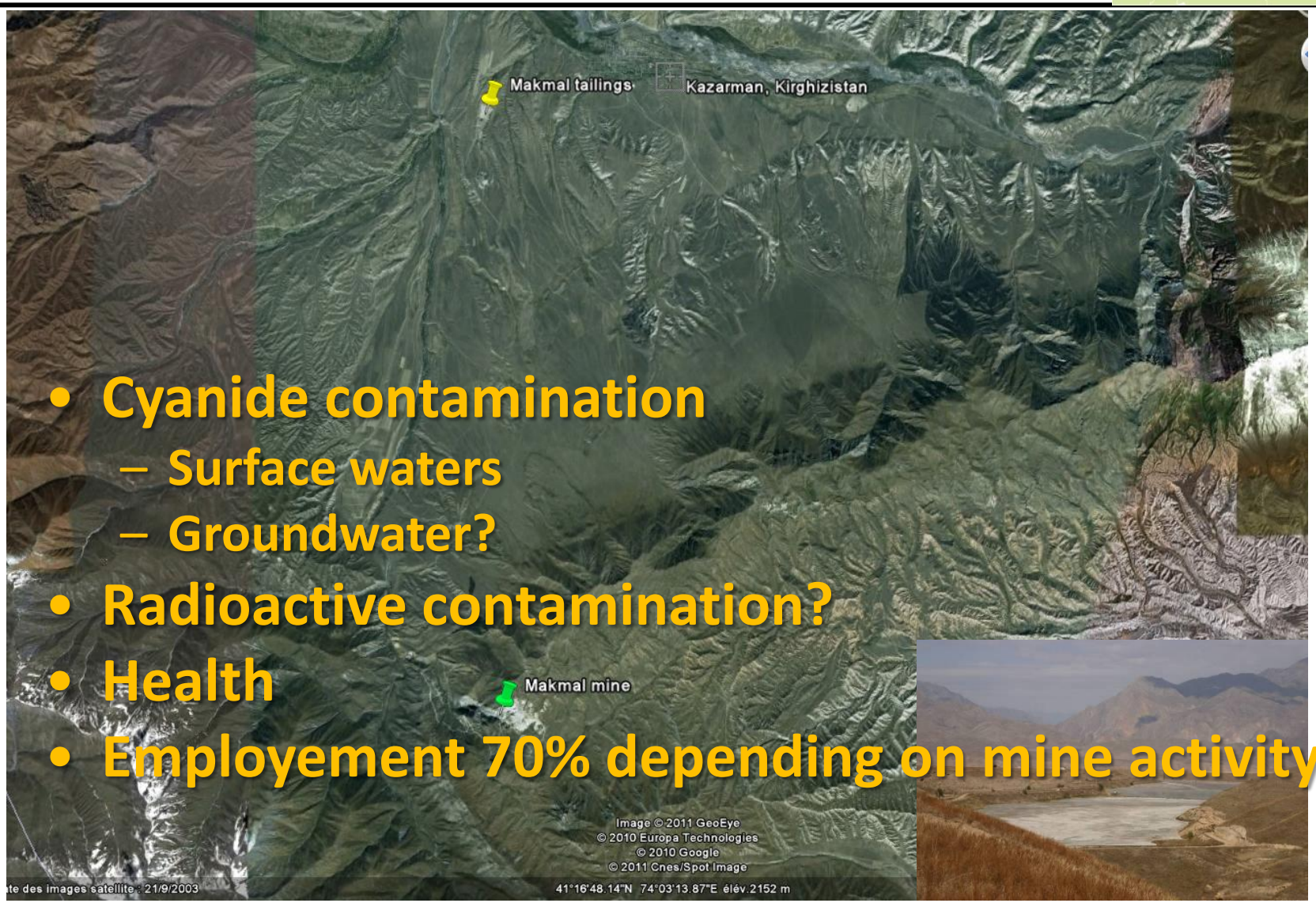


- The largest coal field in ZA
  - More than 60 x 60 km
- AMD (Acid Mine Drainage) affecting
  - Drainage system and wetlands
  - Urban areas
- Coal fires
- Dust
- Subsidence
- Landvalue degradation
- Uncontrolled urban sprawling

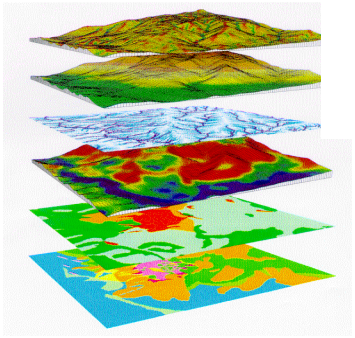
Emalahleni Test Site

© 2009 Cnes/Spot Image
Image © 2009 DigitalGlobe
©2009 Google
Date des images satellite : 11 déc. 2004
25°51'21.38" S 29°08'41.39" E
Altitude 11.09 km

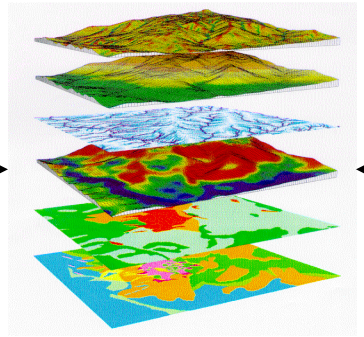
EO-MINERS Makmal – Kazarman gold mine demo site (KG)



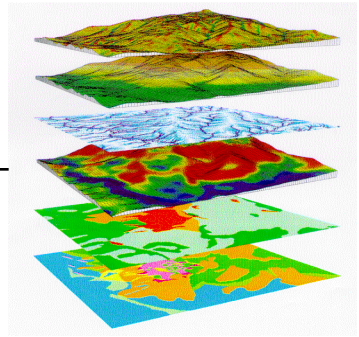
- Cyanide contamination
  - Surface waters
  - Groundwater?
- Radioactive contamination?
- Health
- Employement 70% depending on mine activity



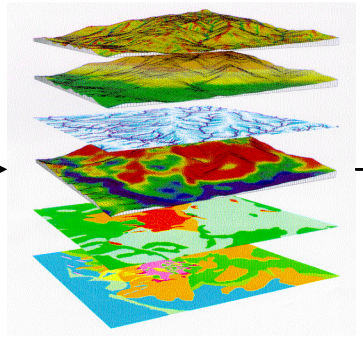
Project T0



Affected Environment



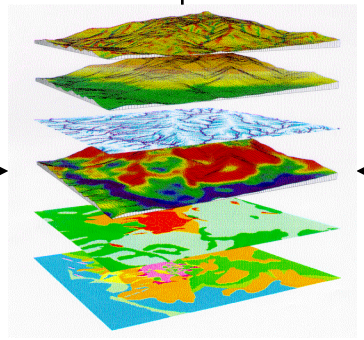
Environment



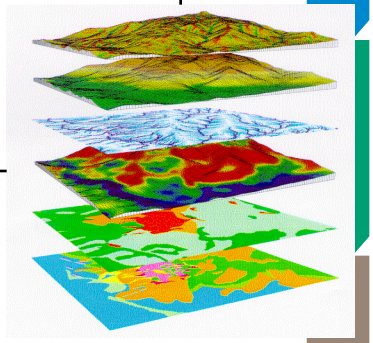
Pathways
Transfer media

Environmental and societal impacts

Societal acceptability

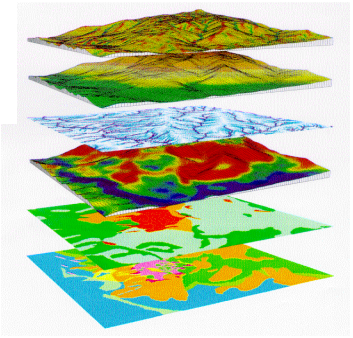


Affected Populations

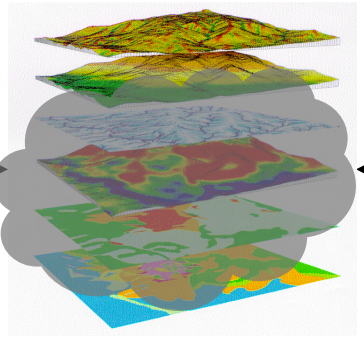


Populations

EO and GIS in societal acceptability – a simplified conceptual model



Project Tn



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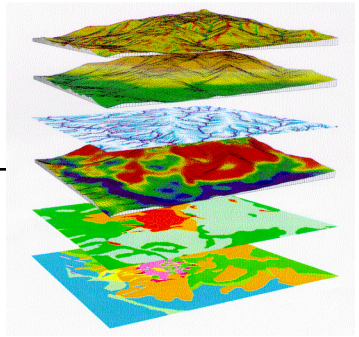
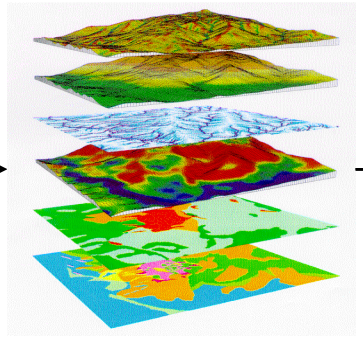


Environment



Pathways
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Environmental and societal impacts

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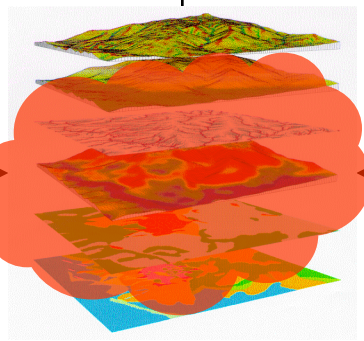
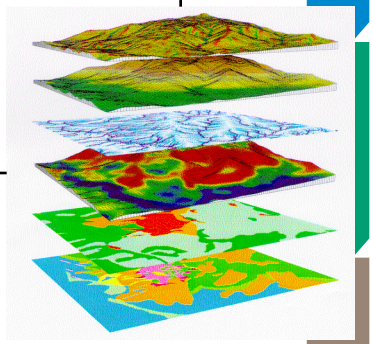


Affected Populations



Populations

EO and GIS in societal acceptability – a simplified conceptual model

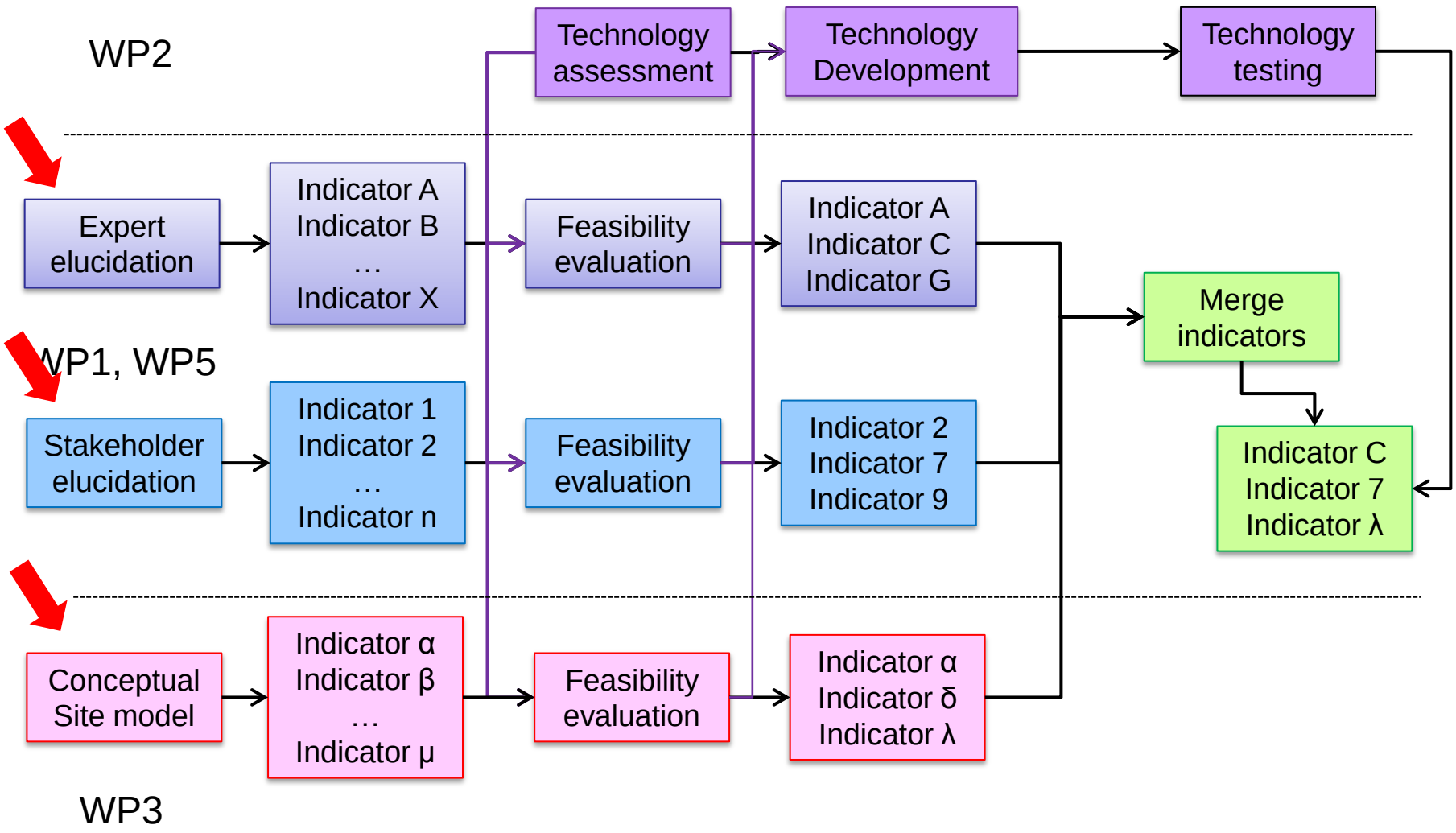
EO tools and methods

- **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

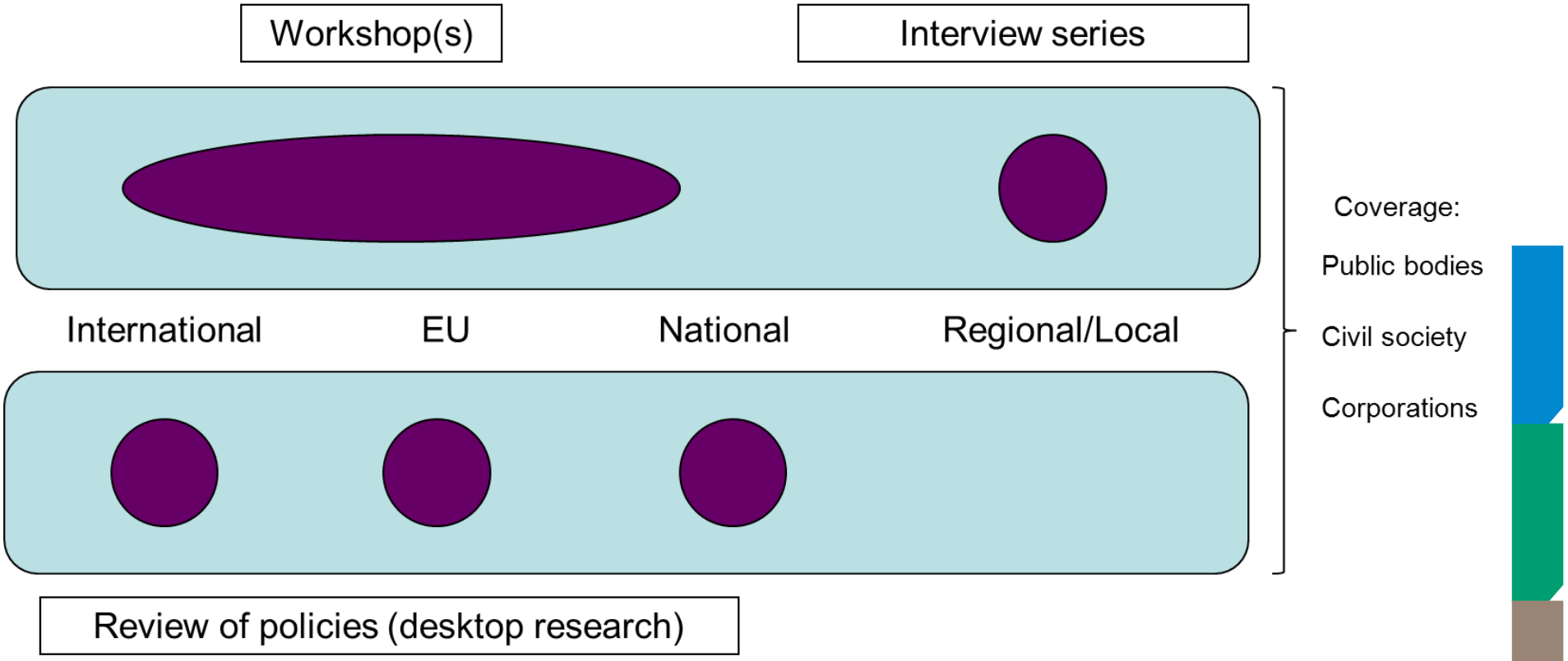
Developing indicators framework

- **The development of meaningful indicators is a social and not an engineering process**
- **The social process defines what to indicate for whom and why**
- **We 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



Defining information requirements by stakeholders

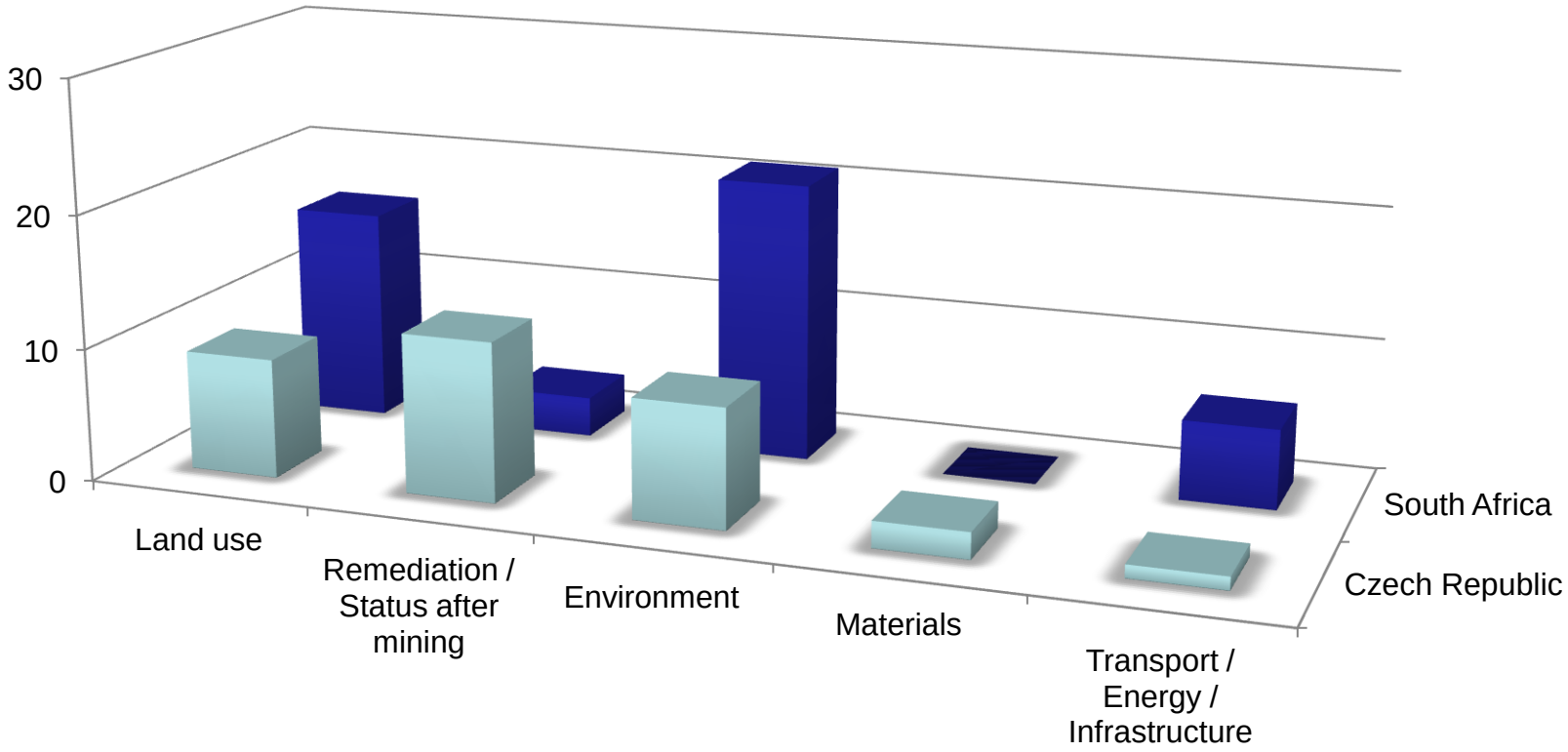


Local stakeholder interviews

Interview of Chet Bulak village authorities, Kyrgyzstan

Stakeholder derived indicators

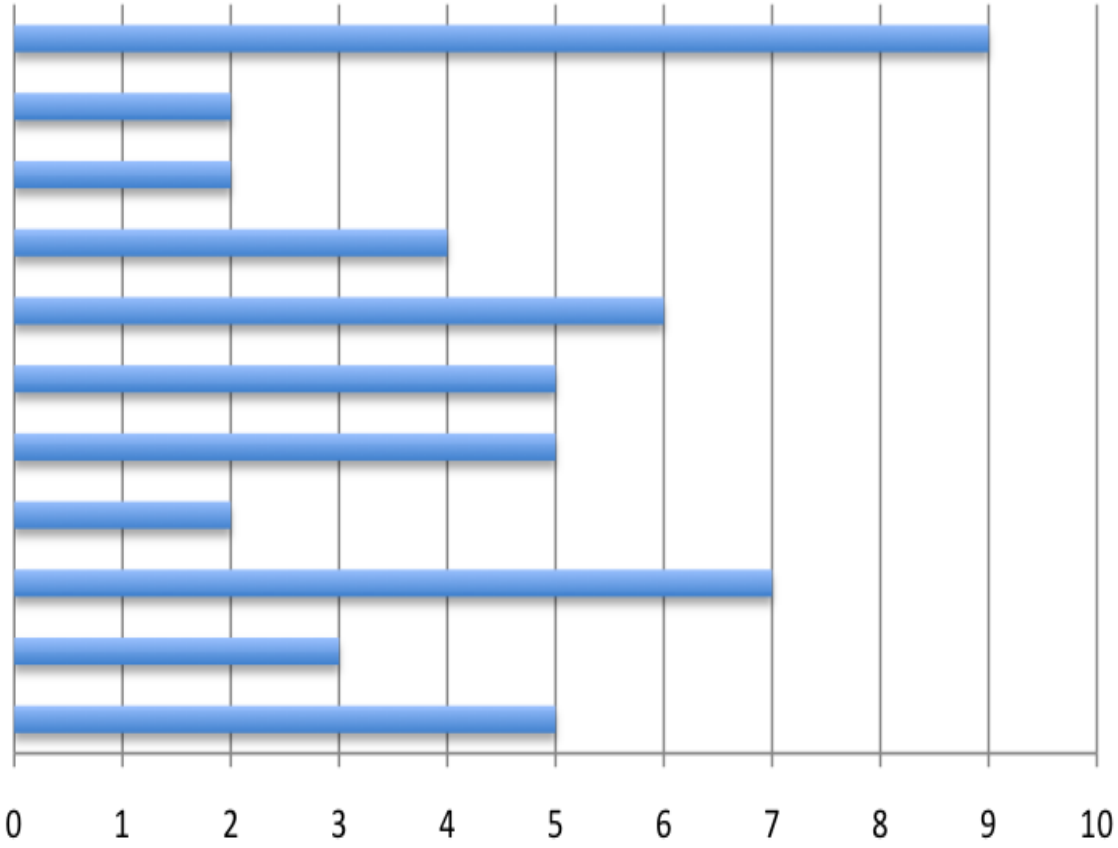
Themes covered by information requirements of local/regional stakeholders



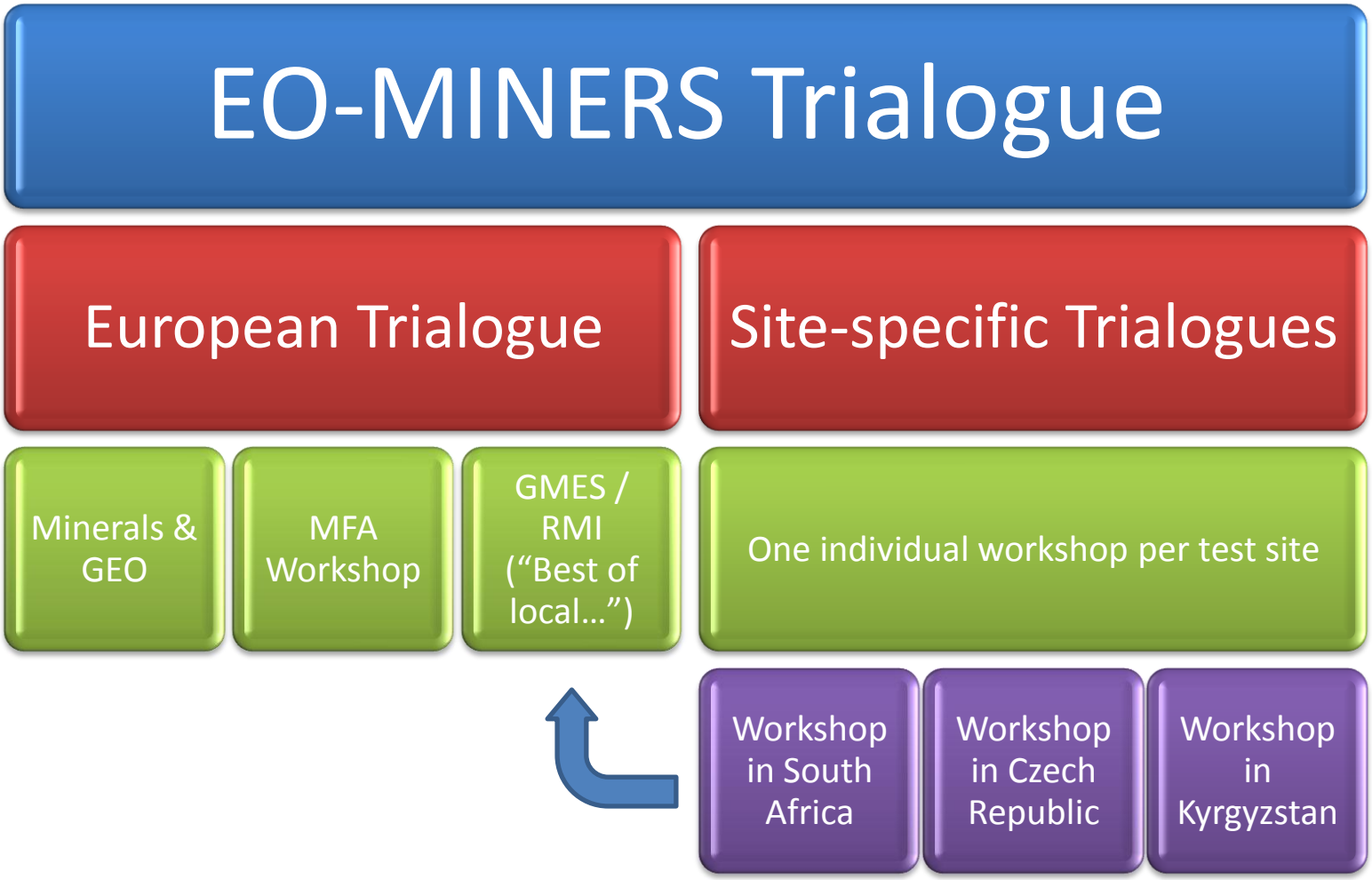
Expert derived indicators

- **Theme of indicators**

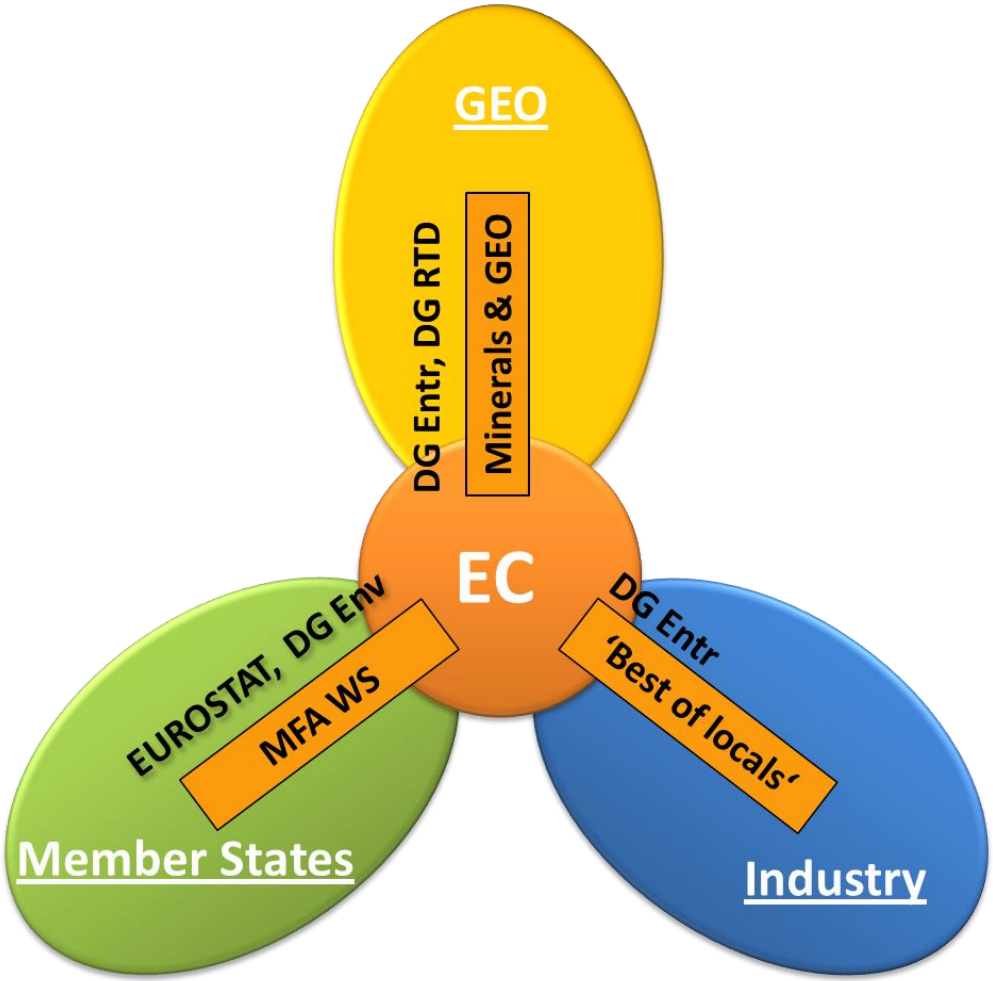
a. **Land Use**
b. **Mass flows**
c. **Energy Flows**
d. **Air related**
e. **Water related**
f. **Transport**
g. **Geotechnical**
h. **Accidents**
i. **Social impacts**
j. **Regional development**
k. **Economic vulnerability**



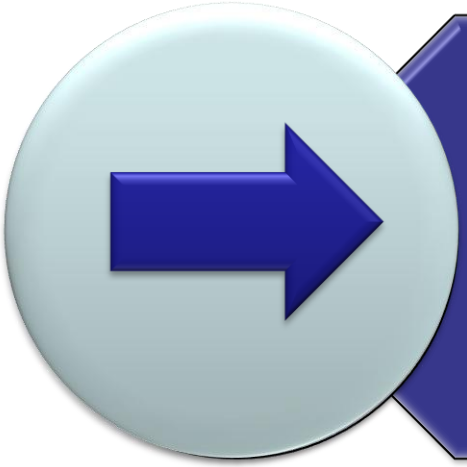
Trialogue Structure



European Trialogue



European Trialogue



Expected outcomes

- Obtain perception about indicators
- Obtain perception about EO-MINERS products
- Gap analysis, requirements for the future
- Suitability of results for contributing to policy development

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

Site-specific trialogues

Get stakeholders to talk to each other about impact assessment and suitable (joint) actions

Acquired data

	RS Image data		DEMs		EO & GIS	
test site	data set	Data type	Data set	Resolution	Data set	Data type
Sokolov	Hymap 2009	Hyperspectral VNIR - SWIR	Cartosat 2009	Resolution 5 m	ASD spectra	Spectral library
CZ	Hymap 2010		Cartosat 2010	Resolution 5 m	TIR spectra	Spectral library
	AHS 2011	Hyperspectral TIR	Cartosat 2011	Resolution 5 m	Temperature measurements	
	orthopohoto mosaic	Aerial photographs	GEODIS	Resolution 10 m	Dust measurements	
	CASI	Hyperspectral VNIR	ASTER	Resolution 30 m	Geology	
	ALI	10 bands VNIR - SWIR			Land cover	Land cover 2006
	ASTER	15 bands VNIR – SWIR - TIR			Topographic data	
Witbank	WorldView_II	8 bands VNIR	WorldView_II	Resolution 1 m	ASD spectra	Spectral library
ZA	Landsat TM series	7 bands VNIR - SWIR	SRTM	Resolution 90 m	TIR spectra	Spectral library
	SPOT	2.5 m color			Temperature measurements	
	thermal imagery 2011	FLIR			Dust measurements	
					GIS	
	AISA dual 2012	Hyperspectral VNIR - SWIR			ALERT	Real time electrical resistivity tomography
Makmal	WorldView_II	8 bands VNIR	WorldView_II	Resolution 1 m	geology	
KG	Landsat TM		SRTM	Resolution 90 m	Chemical analyses	
	SPOT	2.5 m color	ASTER	Resolution 1 m	ASD spectra	

Thanks for your attention!

Contact : s.chevrel@brgm.fr

Expert derived indicators (1)

- **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

Expert derived indicators (4)

- **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