



Environmental hazards associated with mining activities in the tropics (EDITOR)

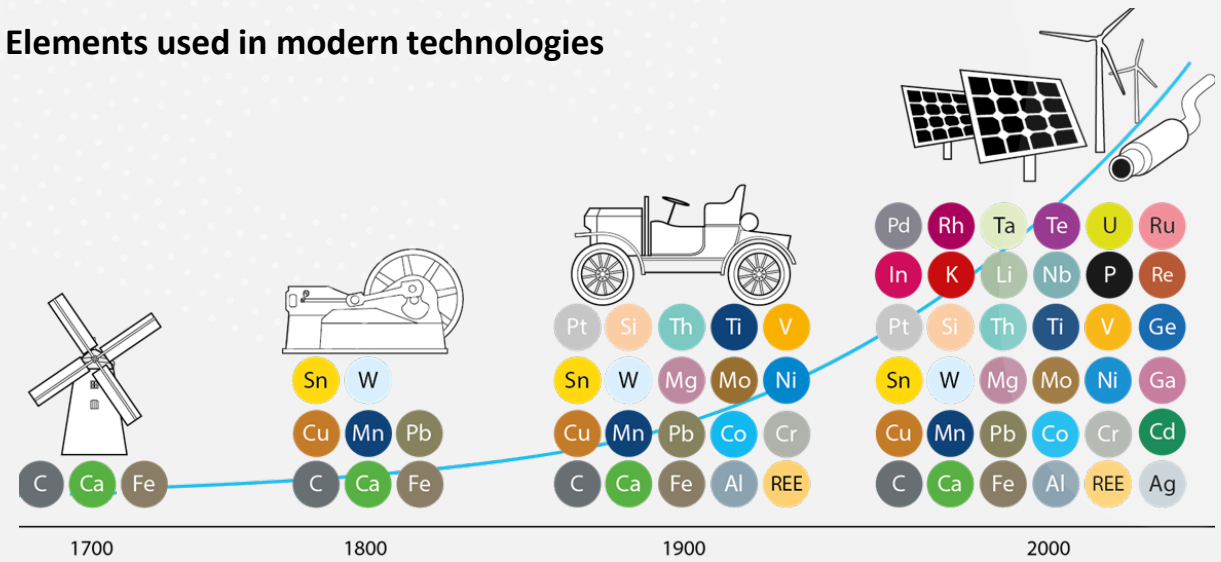


University of Antwerp

Energy transition relies on minerals

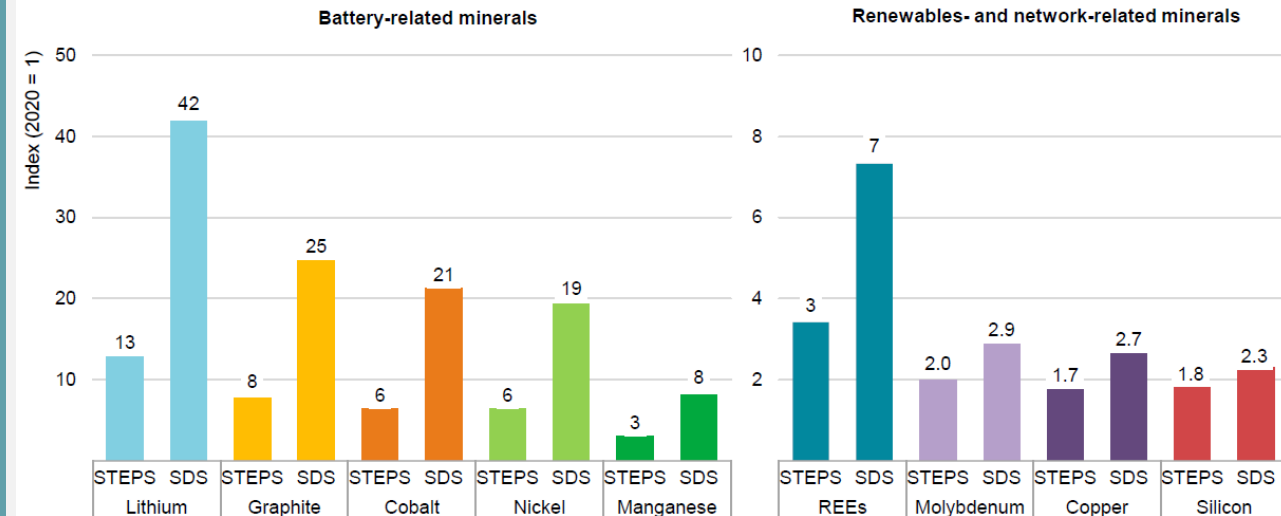
- Energy transition is an increasingly prominent question
- Relies on the use of critical minerals
- Growing **demand** for wider range of metals to follow the zero-emission targets
- Projection for the sustainable development scenario show drastic increase of the demand

Elements used in modern technologies



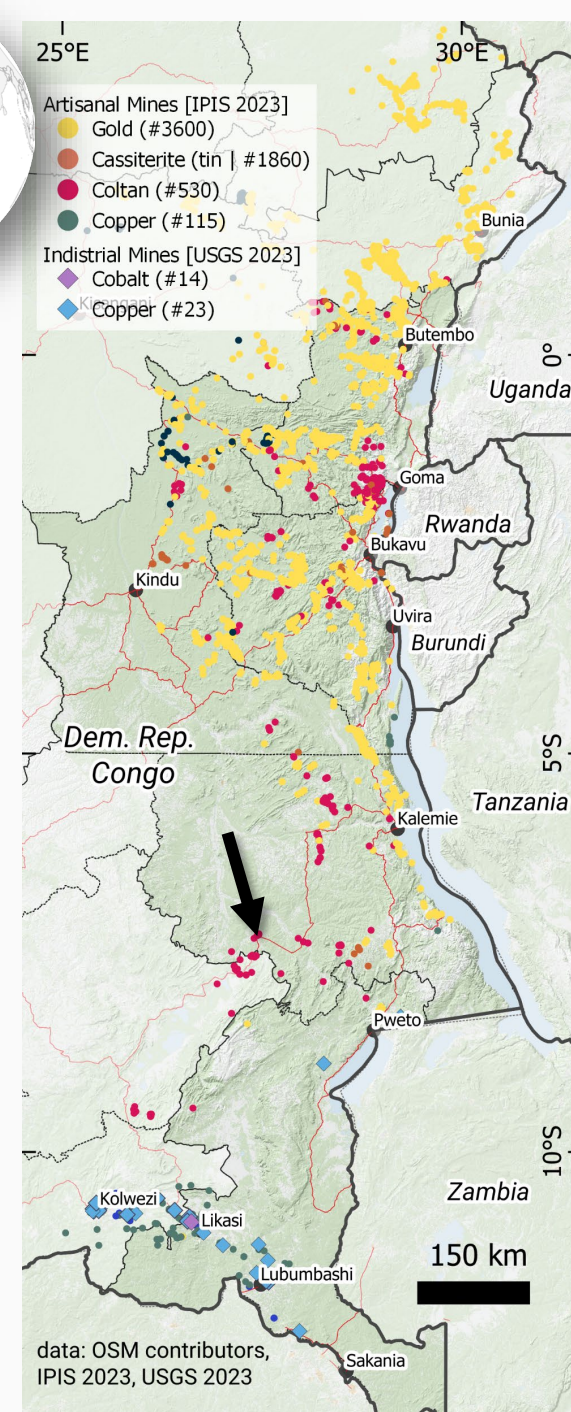
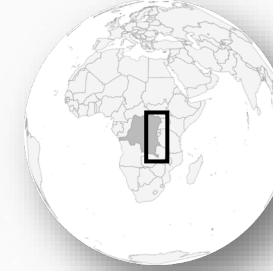
Growth in demand for selected minerals from clean energy technologies in 2040 relative to 2020 levels

STEPS = Stated Policies Scenario / SDS = Sustainable Development Scenario



Eastern DRC: A Major Mineral Frontier

- **Increased demand and value** sparks a surge in mining activities in **mineral-rich DRC**
 - Abundance of Cobalt, Gold, Lithium, Tantalum, Tin, Niobium
 - Combination of **artisanal and industrial** mining
- DRC world ~70% of Cobalt and 60% of Tantalum
- Lack of **environmental & social governance** in both artisanal and industrial mining
- Major **environmental impacts** and natural resource degradation



Aerial view of artisanal mining for tin and coltan.
Manono, Katanga © Google Earth 2022



Artisanal mining around historic open cast tin mine, a current industrial lithium exploration project.
Manono, Katanga © Anouk Borst, 2022

Belgian Earth Observation Day Hasselt 14th May 2024

Mining Induced Environmental Changes and Impact

Mining is responsible for severe, uncontrolled and rapid environmental changes

Changes in landscape structure

- Land use/land cover
- Deforestation
- Road construction

Influence of hydrological regime

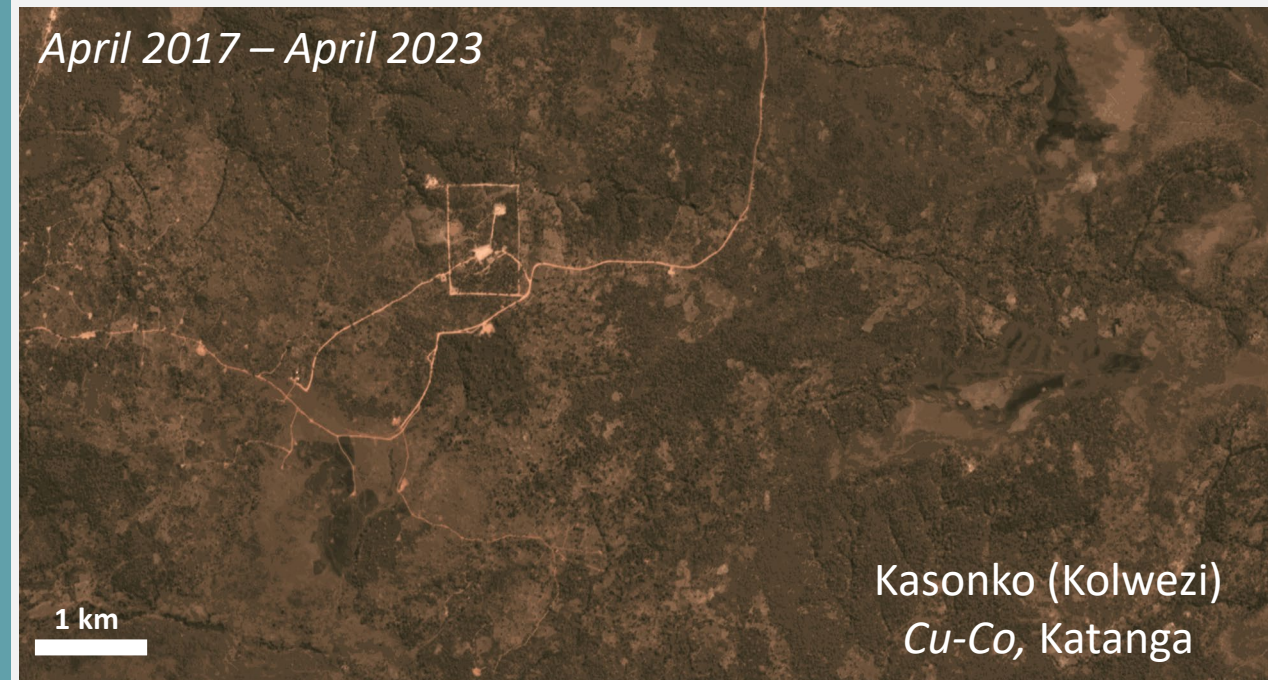
- Water contamination
- Sedimentation of water stream

Geomorphological processes

- Weathering
- Landslides and soil erosion
- Fluvial processes
- Aeolian processes
- New anthropogenic forms

Influence on fertility of soil

- Soil contamination
- High levels of dust
- Land use change



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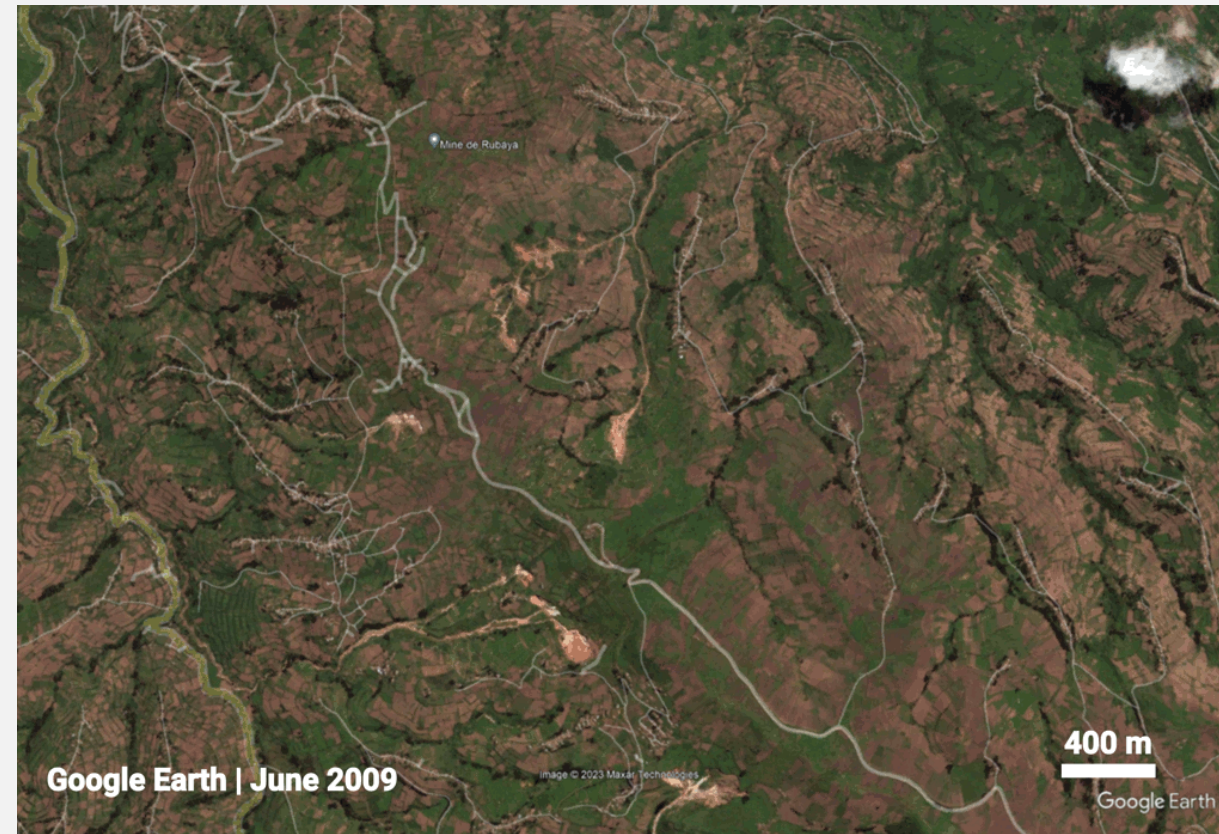
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EDITOR



Google Earth | Aug. 2021

Planetscope
June 2022

100 m

400 m

Google Earth

Rubaya, Massisi (coltan mining)

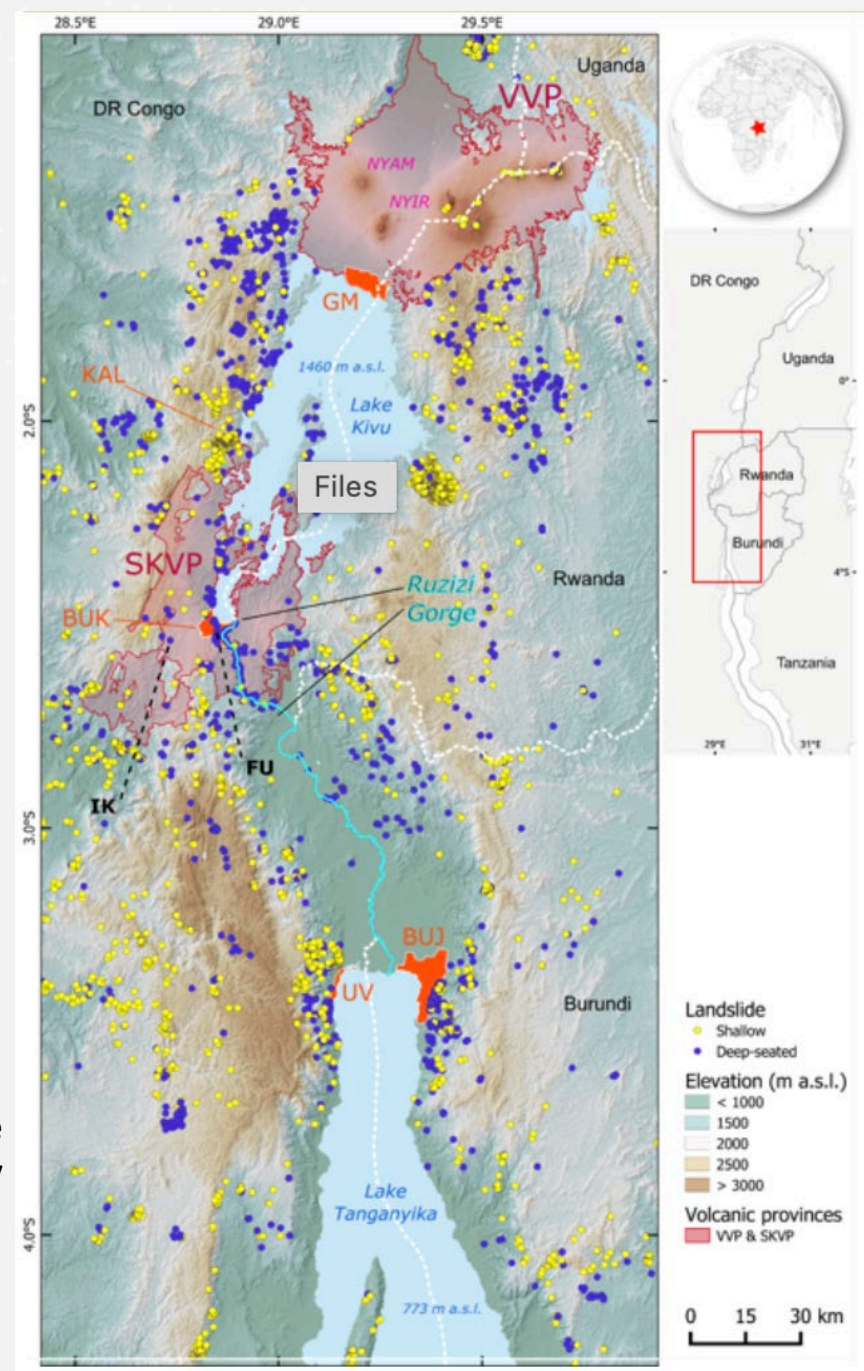
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<https://floodlist.com/africa/dr-congo-landslide-north-kivu-may-2023>

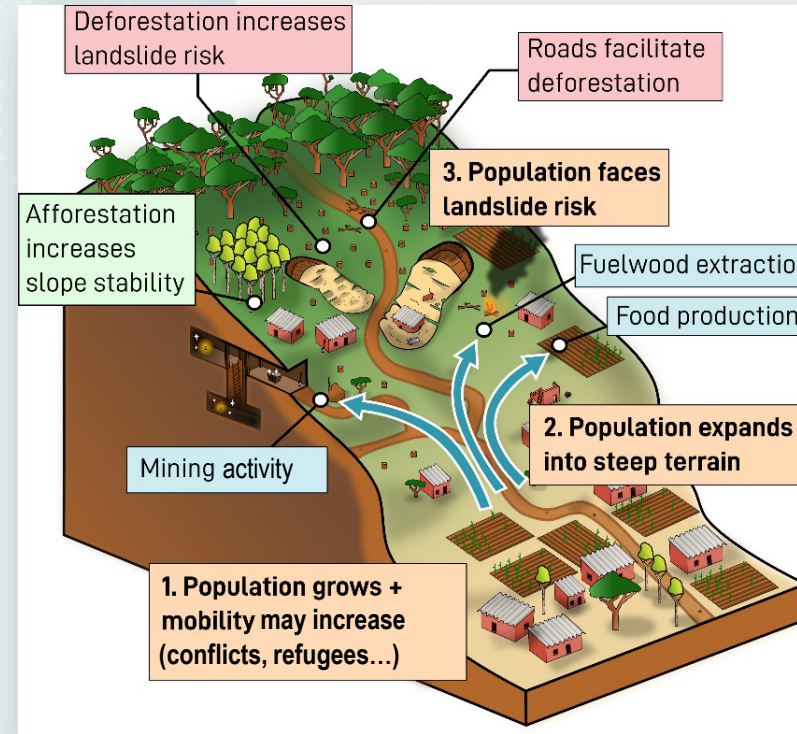
Eastern DRC: an area prone to geo- hydrological hazards

- Geology / Geomorphology / Climate interactions
- Fast uplifting area (edge of active rift)
- Heavy rains, deep weathering, intense erosion
- High population density
- Human activity, mostly mining

**Regional landslide
inventory**
(>20,000 landslides)



Eastern DRC: an area prone to hydro- geological hazards



Article | Published: 19 August 2021

Historical dynamics of landslide risk from population and forest-cover changes in the Kivu Rift

Arthur Depicker, Liesbet Jacobs, Nicholas Mboga, Benoit Smets, Anton Van Rompaey, Moritz Lennert, Éléonore Wolff, François Kervyn, Caroline Michellier, Olivier Dewitte & Gerard Govers

Nature Sustainability 4, 965–974 (2021) | [Cite this article](#)

1871 Accesses | 14 Citations | 62 Altmetric | [Metrics](#)

Ex.: May 2023 flash floods Kalehe
400 fatalities, 2500 disappeared,
1200 houses destroyed



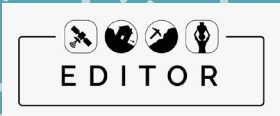
EDITOR project

General objective:

Assessing the **impact of mining** activities and associated landscape disturbance over the mine's **zone of influence**.

Specific objectives:

- **SO-1: Detect** Mining Induced Environmental Changes (MIEC) temporally and spatially with **remote sensing**
- **SO-2: Characterize** MIEC using a remote sensing approach
- **SO-3: Develop** machine learning for **regional trend** assessment
- **SO-4: Analyze** population **exposure and vulnerability** in space and time



Partnership



Mineral characterization, optical remote sensing, hazard assessment, population vulnerability



Mining societal impact



Radar & optical remote sensing, machine learning



Hyperspectral remote sensing (NI)



Centre d'Expertise en Gestion Minière (DRC)



Centre d'Informations et de Recherche sur les Risques d'origine Naturelle (DRC)



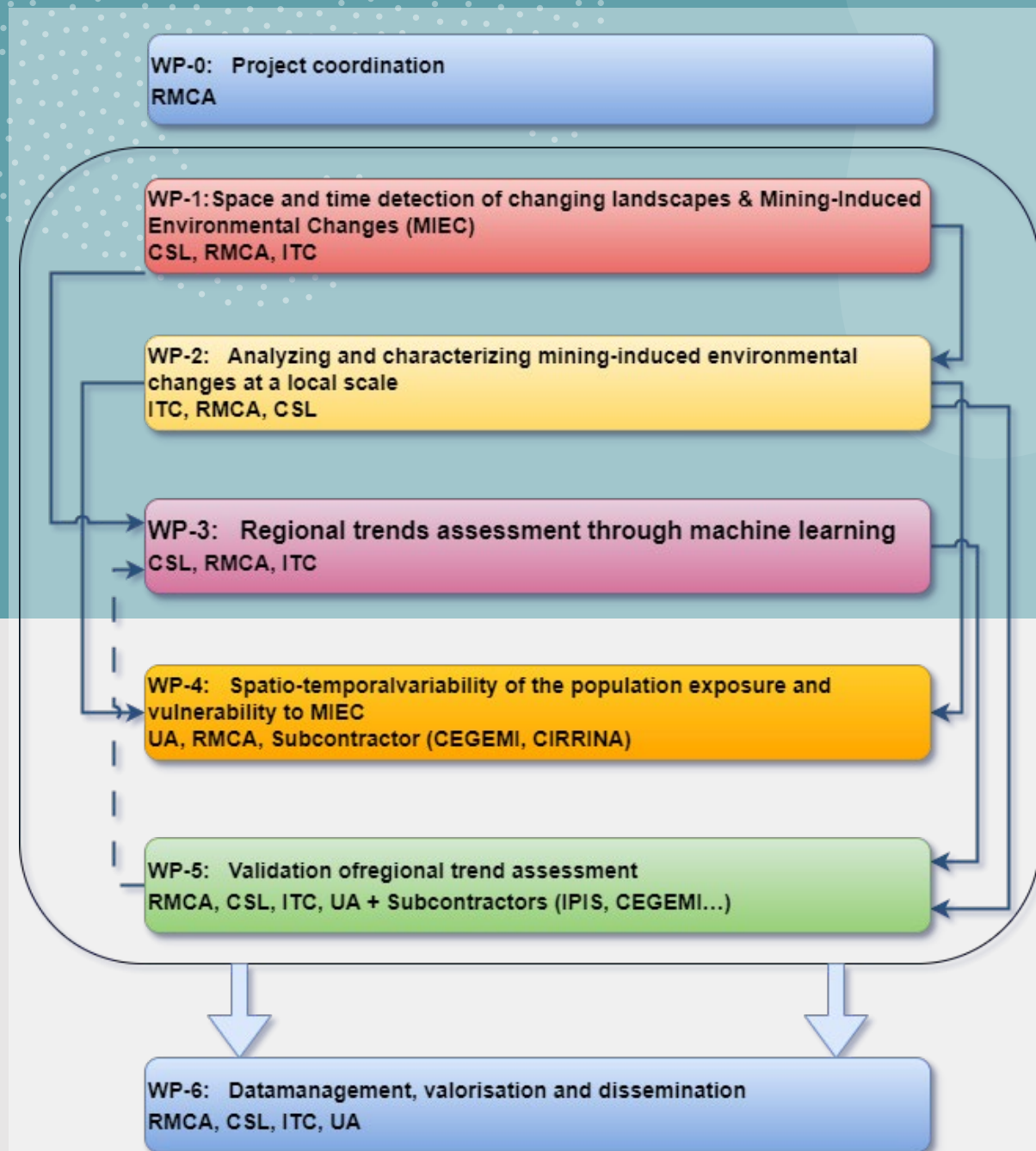
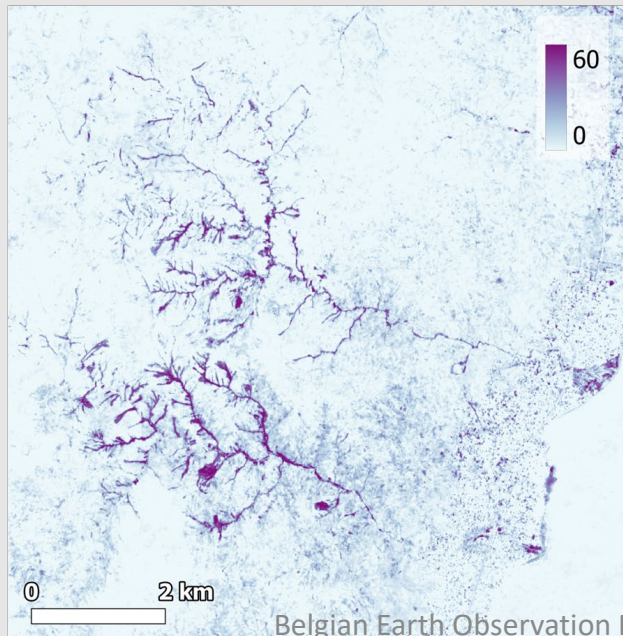
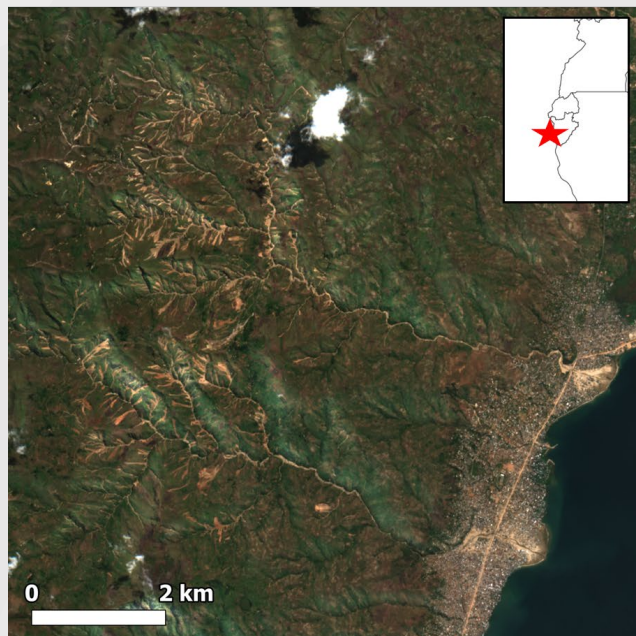
Ministère des Mines - Service Géologique National du Congo (DRC)

WP 1: Space and time detection of changing landscapes & Mining-Induced Environmental Changes (MIEC)

Objective:

Development of a spatio-temporal regional inventory of former and active artisanal and industrial mine sites in the studied region

→ PhD-1 (+ master)

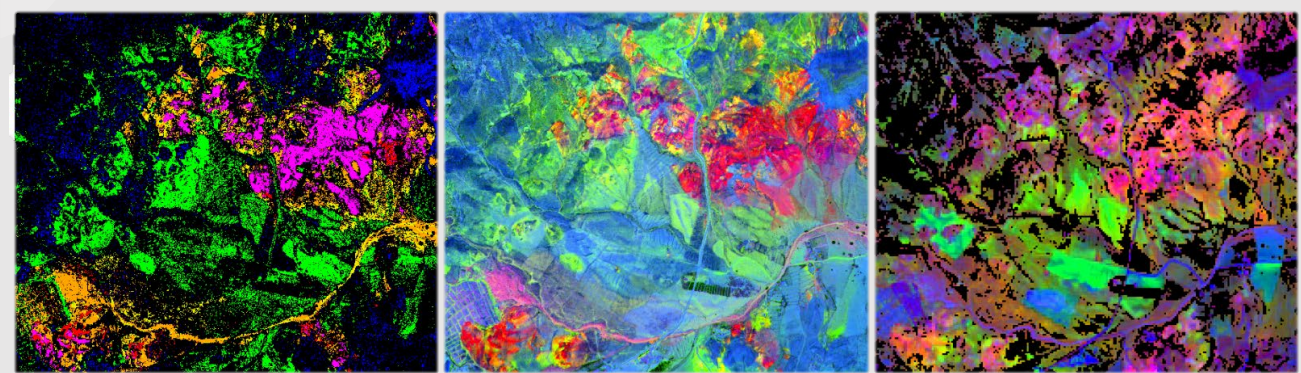
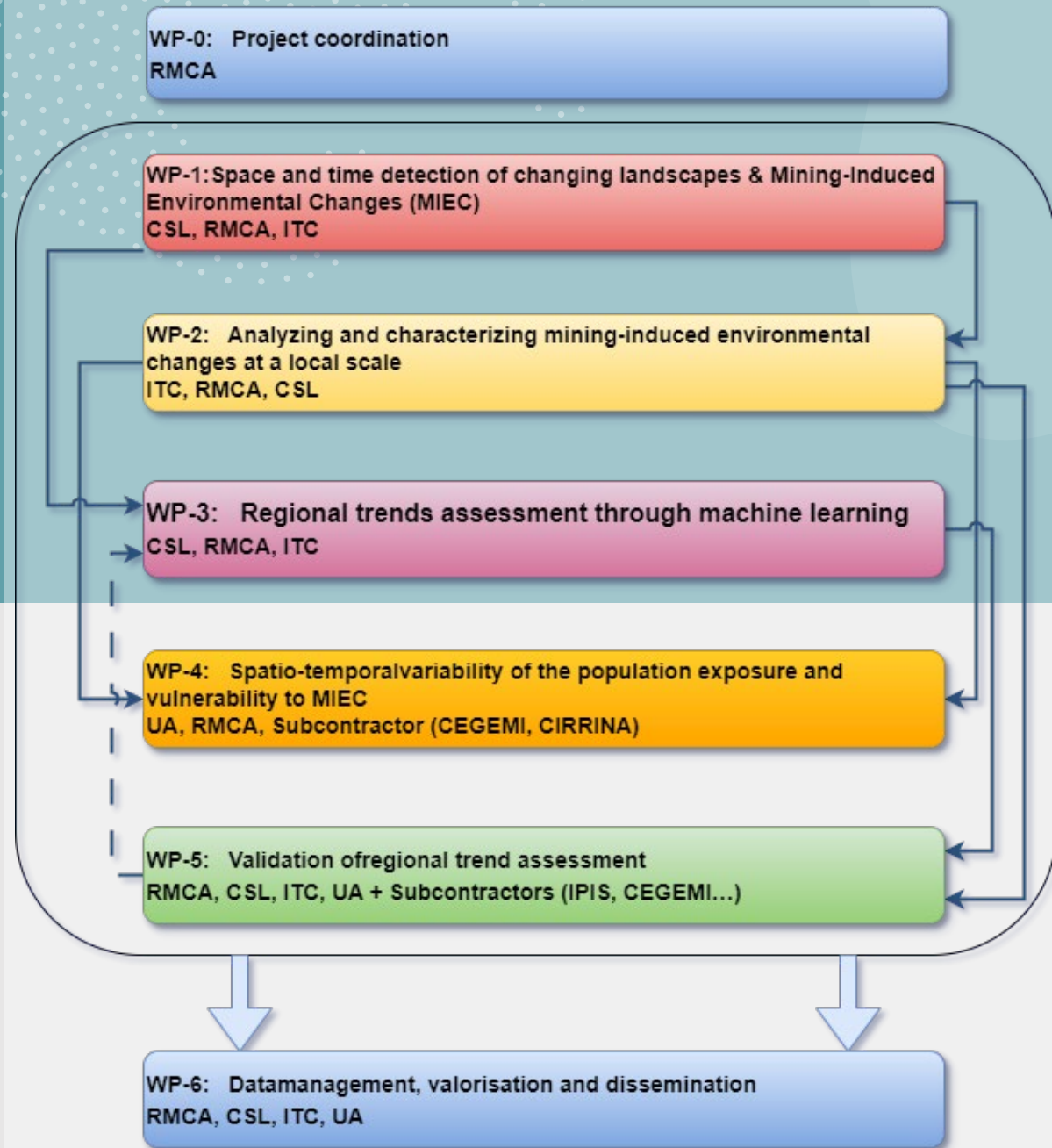


WP 2: Analysing and characterizing MIEC at a local scale

Objective:

Understanding and characterization of identified and selected mining sites and their zone of influence

→ PhD-1



HyMap MRSFF classes

HyMap band ratios

Sentinel-2 band ratios

- Pyrophyllite
- Alunite/Dickite
- Alunite
- Kaolinite
- Illite
- Limestone
- Unclassified

- R_{2100}/R_{2171} ~ Alunite
- R_{2171}/R_{2206} ~ Illite
- R_{2350}/R_{2258} ~ Limestone & seds.

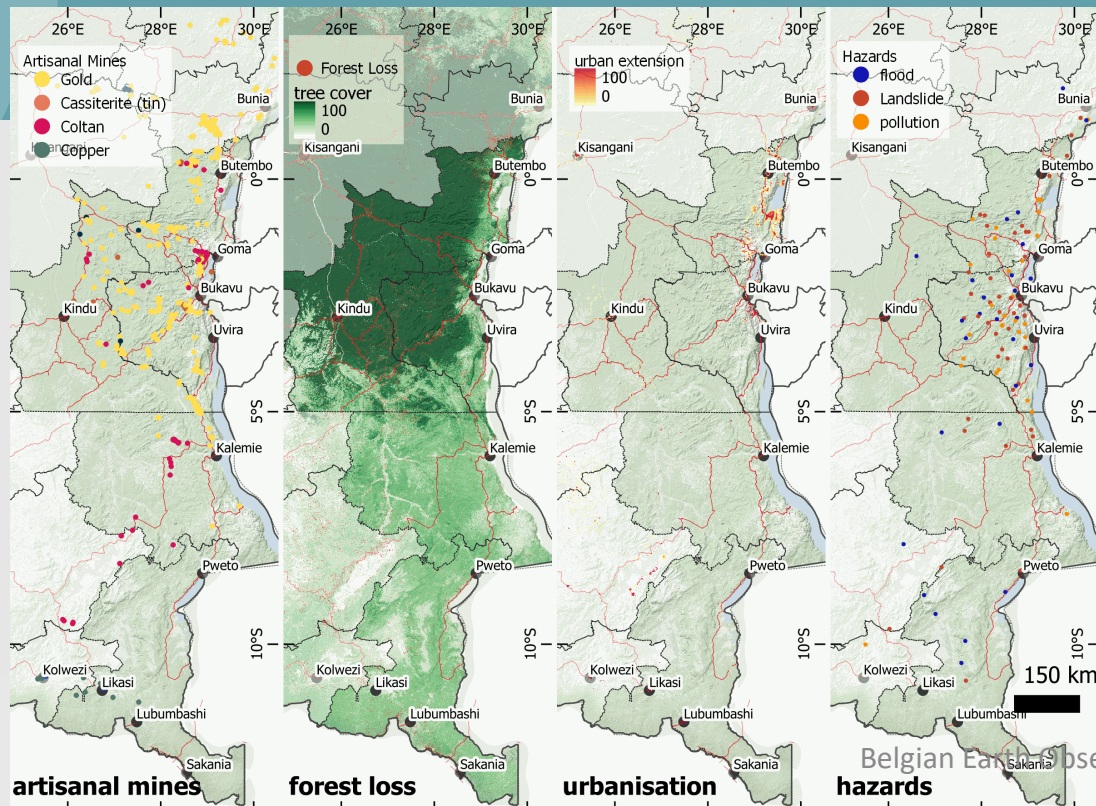
- Band 11/12 ~ Hydroxyl bearing
- Band 04/02 ~ All iron oxides
- Band 04/11 ~ Ferrous iron oxides

WP 3: Regional trends assessment through machine learning

Objective:

Detection of temporal changes and classification of their types and assessing for regional trends

machine/deep learning models



WP-0: Project coordination
RMCA

WP-1: Space and time detection of changing landscapes & Mining-Induced Environmental Changes (MIEC)
CSL, RMCA, ITC

WP-2: Analyzing and characterizing mining-induced environmental changes at a local scale
ITC, RMCA, CSL

WP-3: Regional trends assessment through machine learning
CSL, RMCA, ITC

WP-4: Spatio-temporal variability of the population exposure and vulnerability to MIEC
UA, RMCA, Subcontractor (CEGEMI, CIRINA)

WP-5: Validation of regional trend assessment
RMCA, CSL, ITC, UA + Subcontractors (IPIS, CEGEMI...)

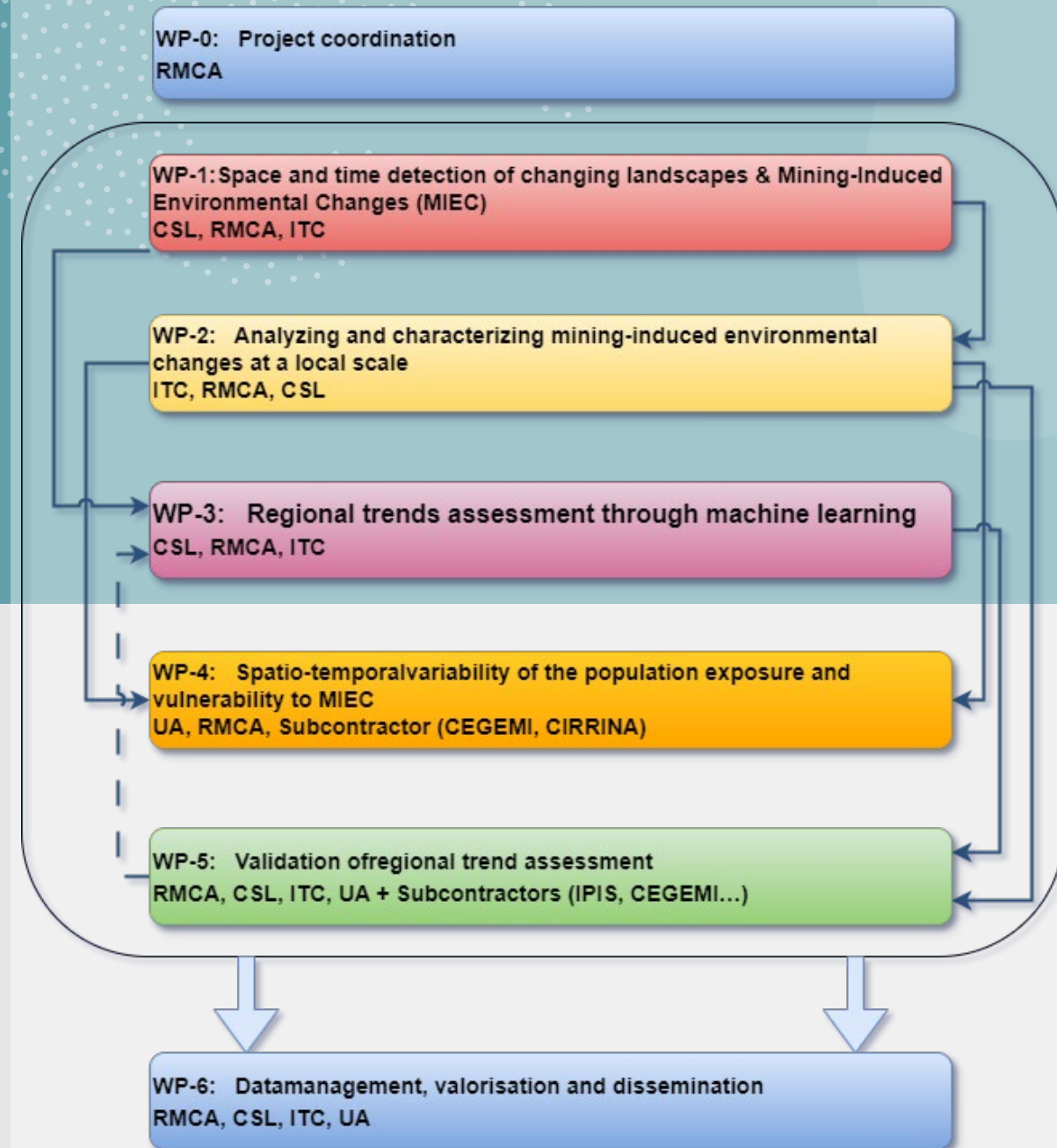
WP-6: Data management, valorisation and dissemination
RMCA, CSL, ITC, UA

WP 4: Spatio-temporal variability of the population exposure and vulnerability to MIEC

Objective:

Analysis of the vulnerability of the population exposed to MIEC in the mining zone of influence

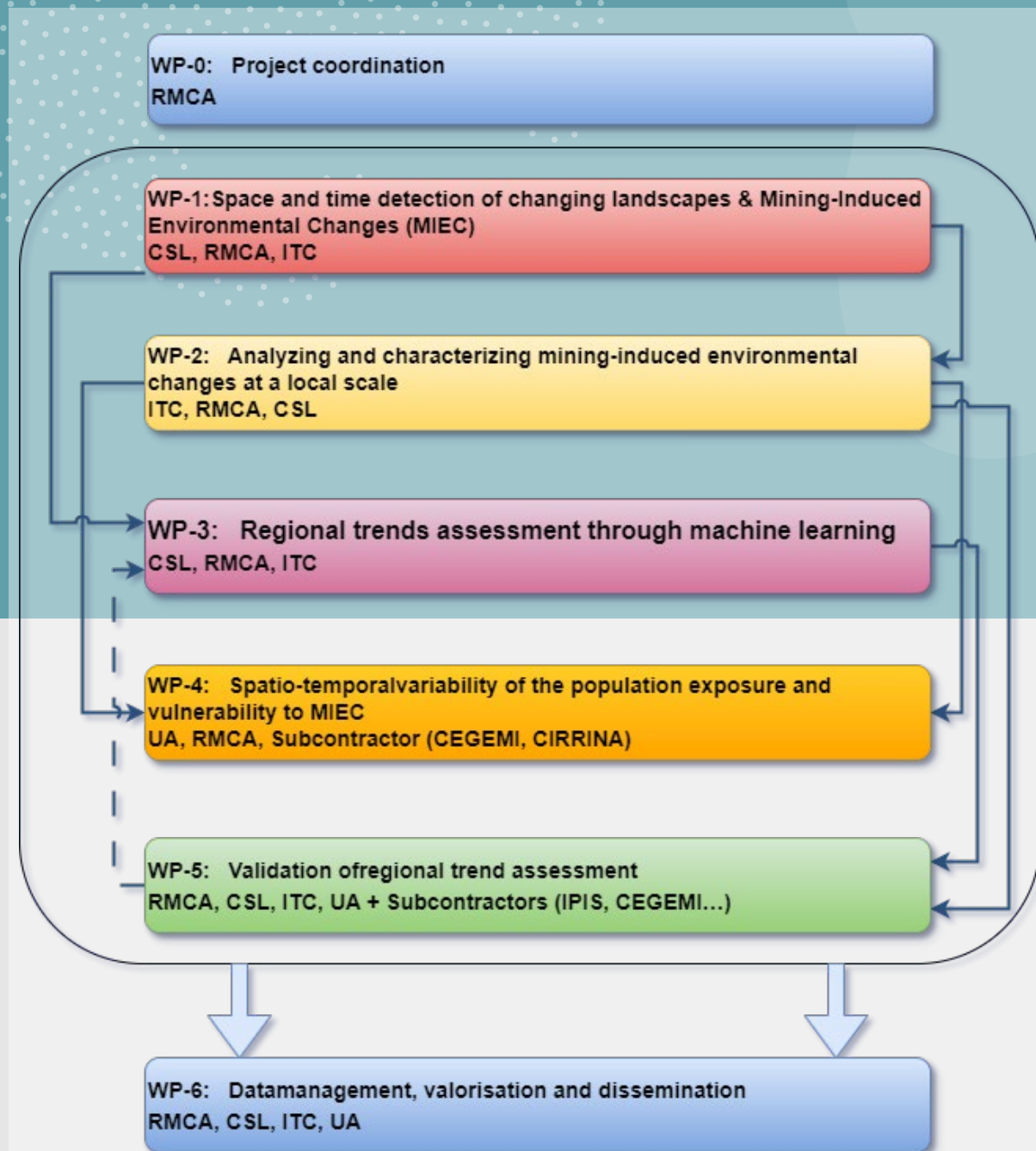
→ PhD-2



WP 5: Validation of regional trend assessment

Objective:

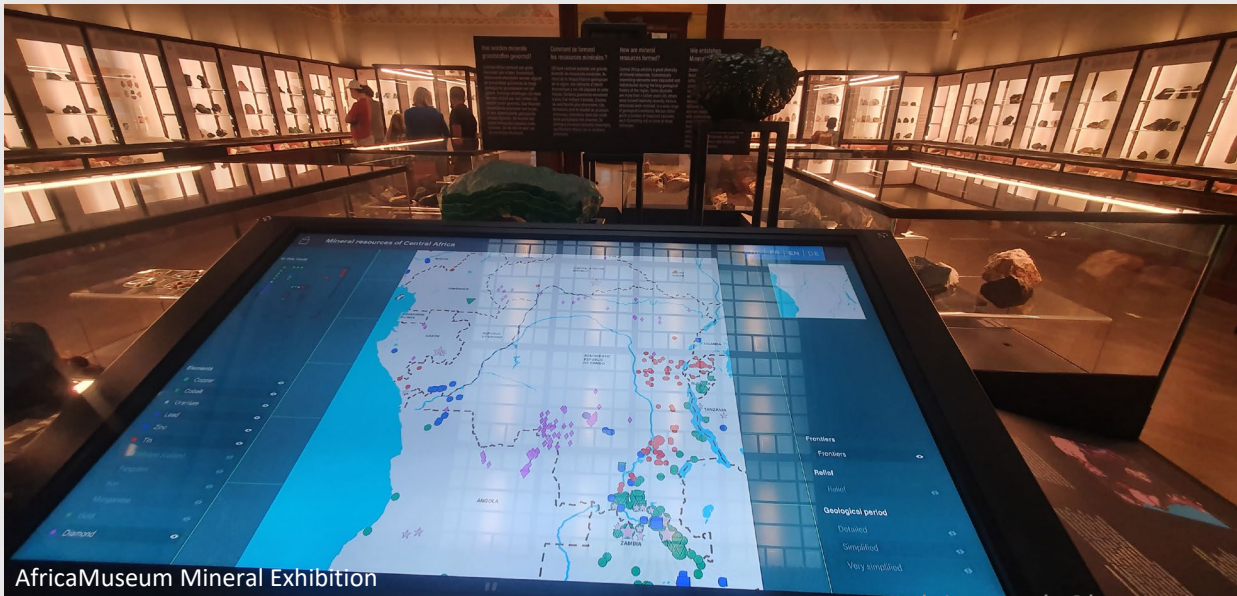
Validating the detected trends and differences between mining sites in terms of environmental impact related to mining activity from the machine learning algorithm developed in WP-3



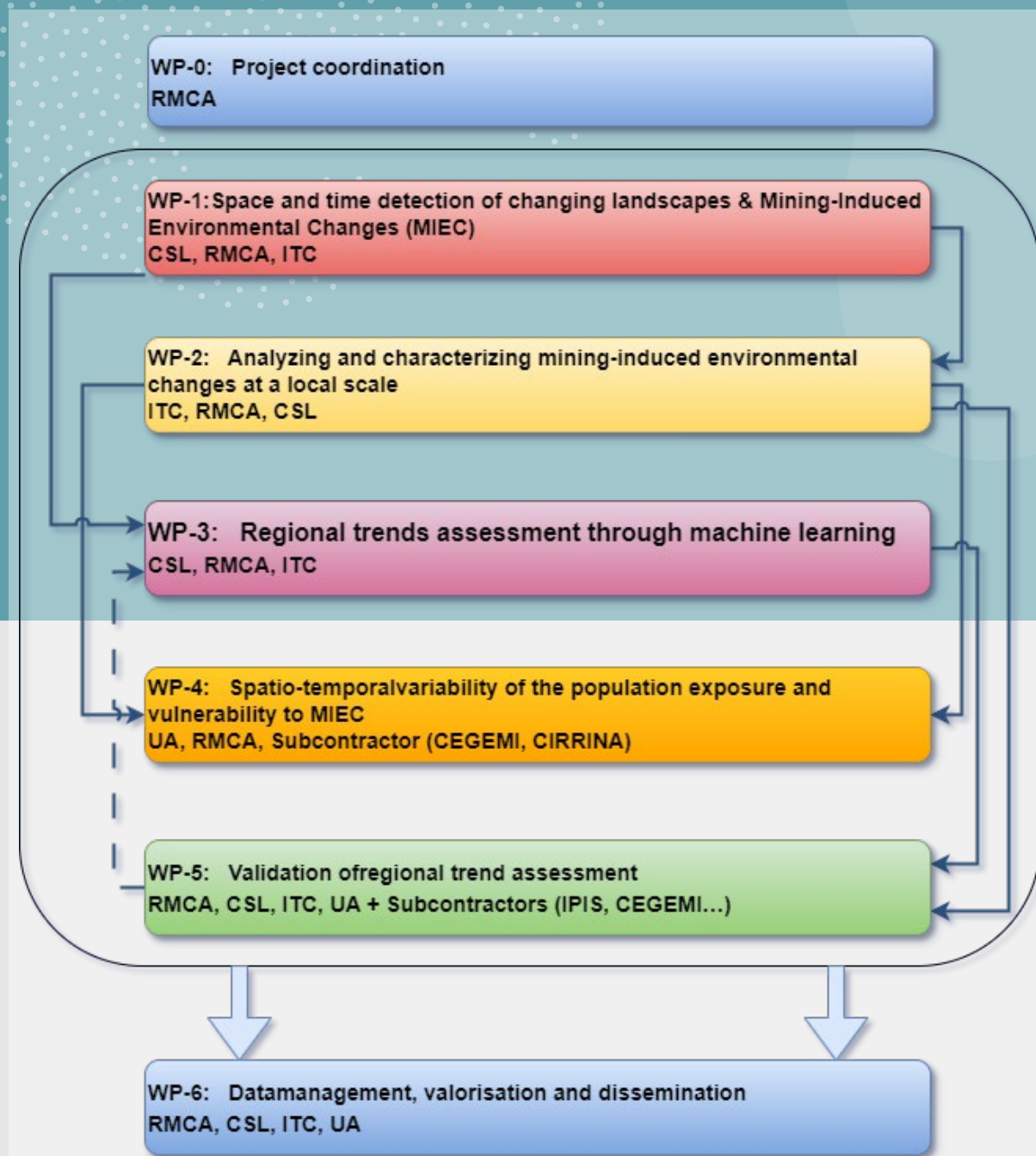
WP 6: Data management, valorization and dissemination

Objectives:

Store, valorize and disseminate the datasets, methods, and results of the project



AfricaMuseum Mineral Exhibition



Status

- Kick-off meeting in Bukavu (DRC) early June
- PhD-1 & 2 selection in June
- Scientific activities start in September



Thank you
