GEO WEEK & MINISTERIAL SUMMIT 2023

EO data and technologies support sustainable practices and mining policies

How can EO support implementing the Critical Raw Materials Act

Gerardo Herrera, DG GROW, European Commission

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GEO GROUP ON EARTH OBSERVATIONS

EO data and technologies support sustainable practices and mining policies

New free satellite hyperspectral data and related mining applications and use-cases

7. 11. 2023, 14.00 – 14.30

Veronika Kopackova-Strnadova

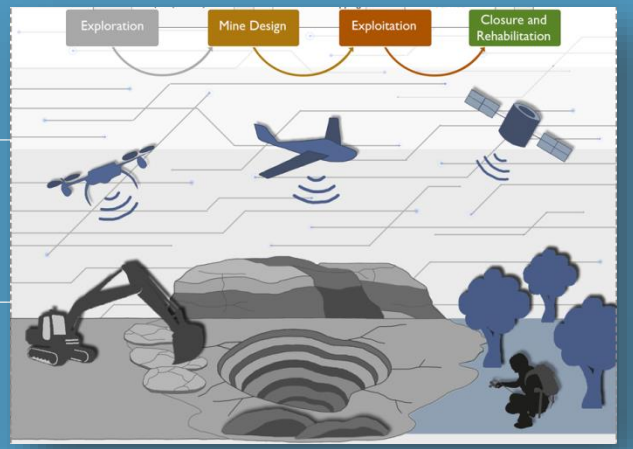
OUTLINE

Earth Observation platforms, sensors and mining value chain

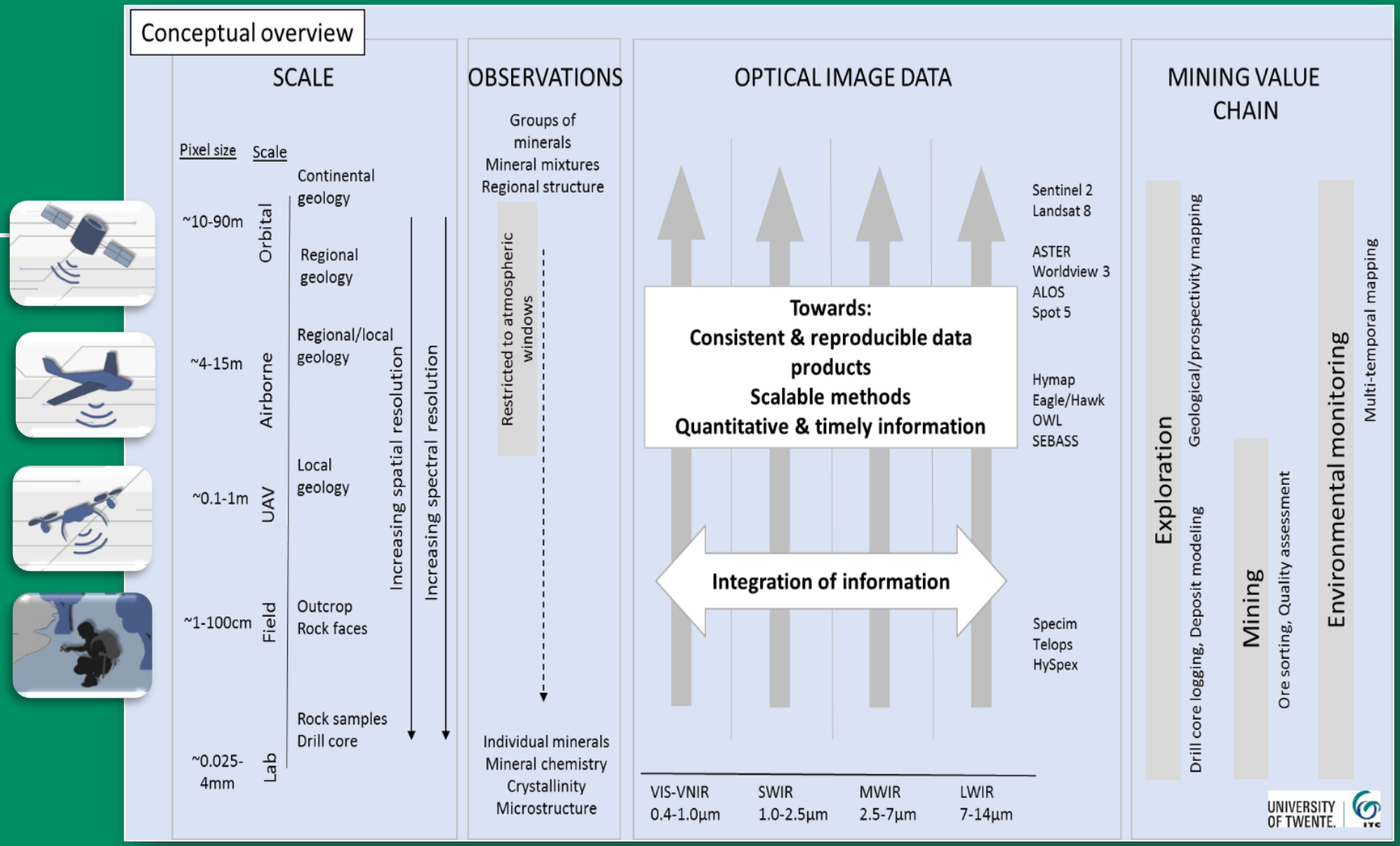
Multi vs. hyperspectral remote sensing

PRISMA satellite HS data

EMIT HS data/ISS

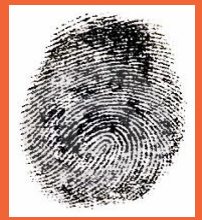


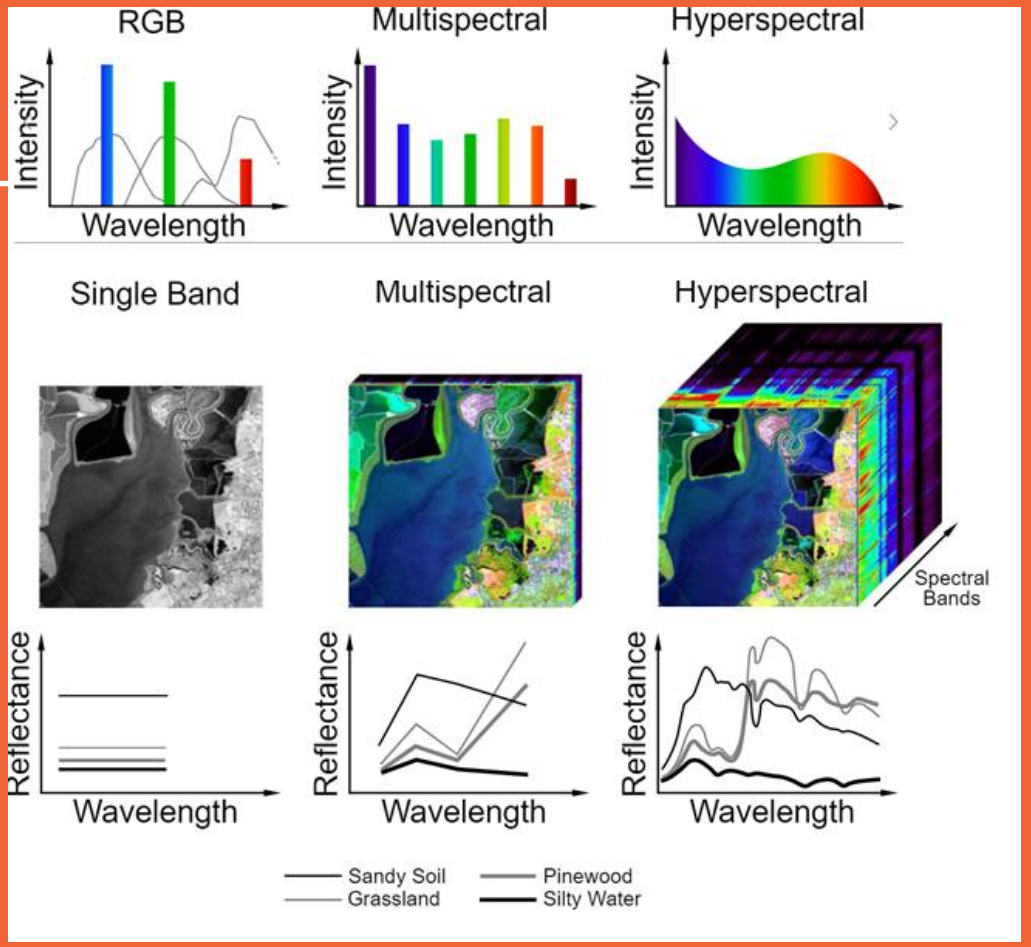
EO for mining



Multi vs. hyperspectral RS

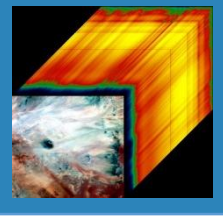
- **Hyperspectral sensors** measure reflected light like many other satellites, but since it is recording hundreds wavelengths, it can detect the fingerprints of the materials on Earth's surface.
  https://earthobservatory.nasa.gov/Features/EO1Tenth/page3.php





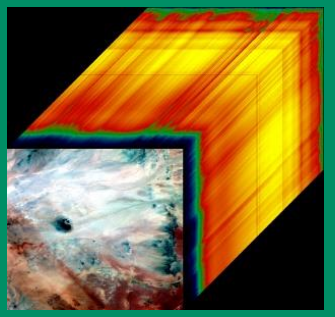
PRISMA satellite hyperspectral data

PRISMA, started its journey in space on **March 22nd, 2019**, aboard a VEGA carrier, completes the current offer by the **Italian Space Agency** an innovative **hyperspectral optical sensor**, able to provide a unique informative contribution for **different applications**.



- **Chemical-physical composition of the surface** of the Earth. In fact, each material has its own **spectral signature**, an actual **fingerprint**: a unique combination of colors, named as spectral bands.
- **PRISMA** is able to analyze this fingerprint from its orbit at an altitude of 615 km

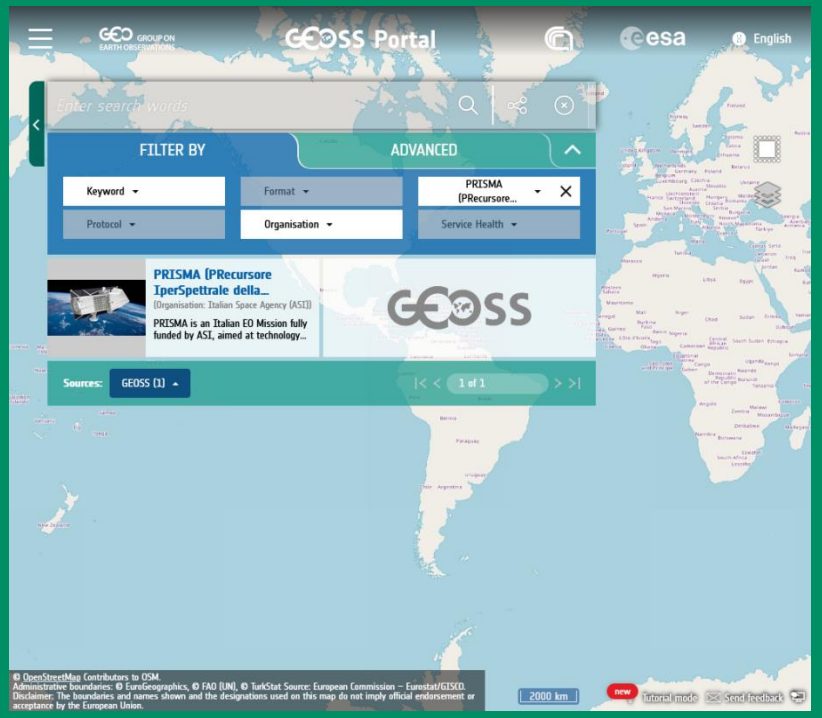
- National EO hyperspectral Mission fully funded by ASI and realized by Italian Industries Consortium led by OHB Italia, Leonardo and Telespazio
- Pre-operational and technology demonstrator for
  - Space qualification of PAN/HYP payload
  - Development of PAN/HYP products up to Level 2D (BOA geocoded reflectance)
- Access to Users since May 2020 https://prisma.asi.it/
- Sensor operates in Pushbroom scanning mode recording the radiation reflected from the Earth surface (spectral cubes) in 400nm – 2505nm spectral window
  - 240 total bands in VNIR (#66, 400–1010 nm) & SWIR (#174, 920–2505 nm), partial spectral overlap
  - High spectral Resolution (better of 14 nm)
  - Medium spatial resolution (30m) and swath (30km)
  - PAN camera offers added capability with 5m resolution



PRISMA data access

https://www.asi.it/en/earth-science/prisma/

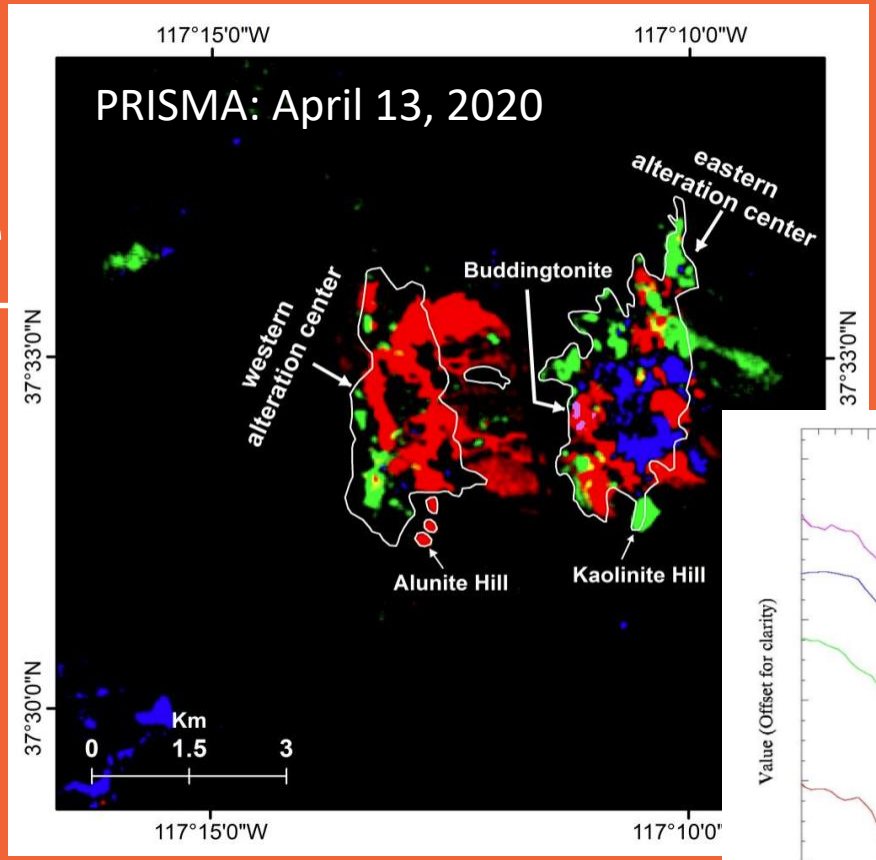
http://prisma.asi.it/js-cat-client-prisma-src/

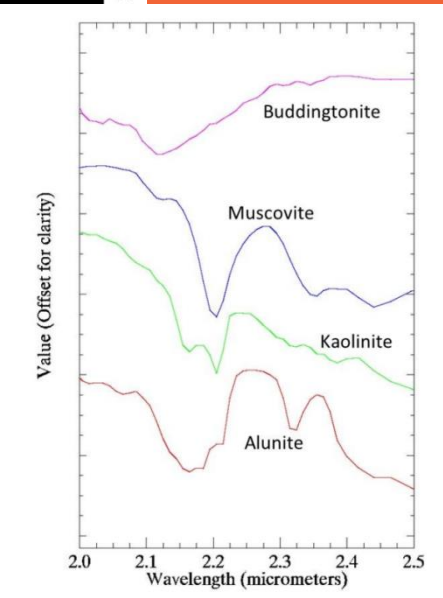


The PRISMA catalogue on the GEOSS portal can be accessed from here

PRISMA: mineral alteration example

- The Cuprite study area in Nevada, USA
- Color composite of the results for alunite (red), kaolinite (green), hydrated silica (blue). The mapping results for the mineral buddingtonite (shown by violet color pixels at the eastern alteration center) are plotted onto the color composite as well.
- PRISMA hyperspectral data can accurately detect alteration minerals such as alunite, kaolinite, illite/muscovite. In addition, the hydrated silica zone at Cuprite was correctly mapped using the PRISMA satellite hyperspectral data.





https://www.semanticscholar.org/paper/Application-of-PRISMA-satellite-hyperspectral-to-at-Bedini-Chen/b5f3748a1e67fcd1475ca921bcef5b274909040f

EM

EMIT
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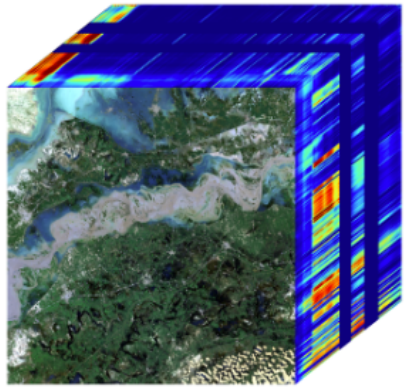
- im
- th
- non-photosynthesizing vegetation, and ten important minerals over arid regions of the planet.

Potential Applications Areas

Natural Hazards

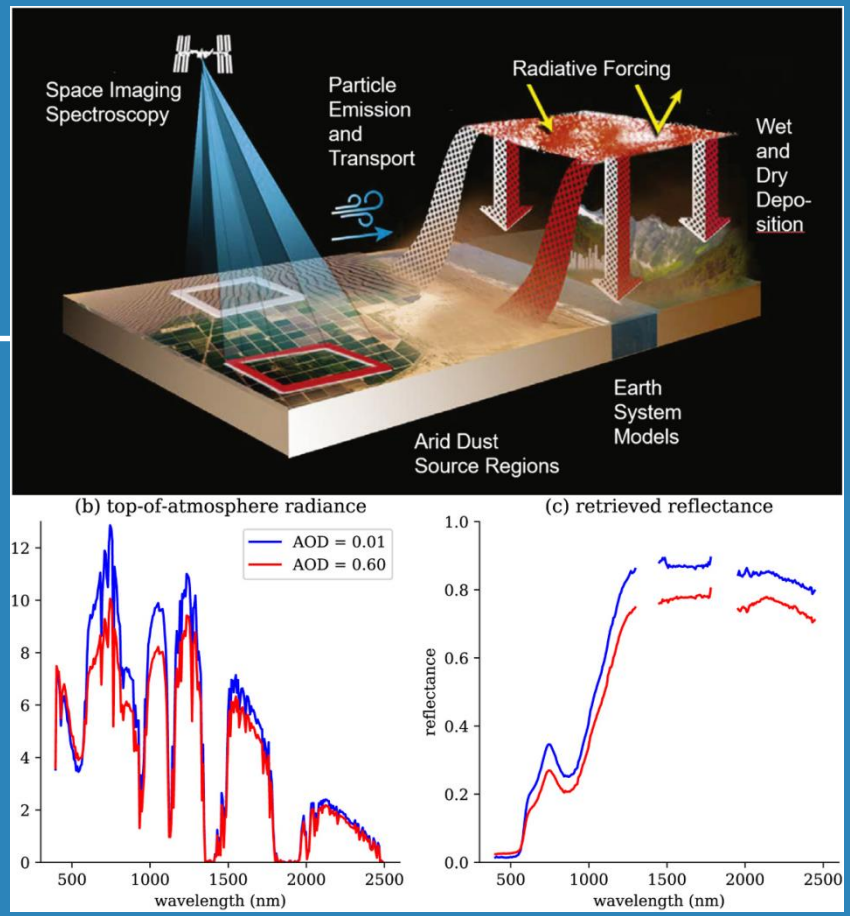


EMIT acquisition over flooded regions in Pakistan during 2022

Assessing the risk of hazards, both before they occur and in response to events, allows for more effective planning and implementation of disaster response efforts. EMIT data could enable detection of a variety of natural hazards and could be used to guide disaster management strategies. For example, it is possible to use reflectance data like those from EMIT to locate the distribution of particular minerals on the slopes of volcanoes which can indicate increased likelihood of debris flows, allowing communities to plan around these high risk areas. Another example is flood response, where EMIT data could provide information on flood extent, ecosystem impacts, and surface water sediment load.

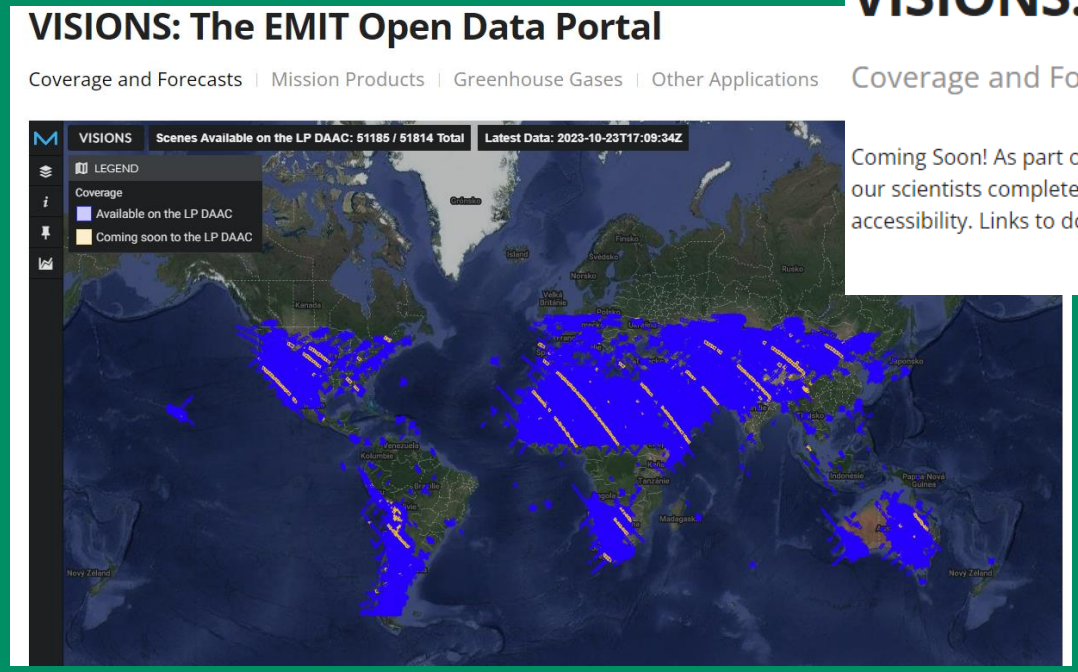
Environmental pollution

From oil spills, to ocean plastics, to acid mine drainage, environmental pollution and damage can impact societies and ecosystems across the globe. Spectrometers like EMIT have been used to map oil extent from the deep water horizon spill in the Gulf of Mexico, plastics in the environment, and to accelerate clean up of an acid mine superfund site in Leadville, CO. As EMIT acquires data across the globe, there is great potential to use them to assist with environmental clean up in response to disasters such as oil spills and remediation efforts to clean up historic mine sites.



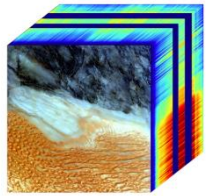
NASA's Open Source Science Initiative provides research grade data products to the public, in addition to its science deliverables. https://earth.jpl.nasa.gov/emit//

EMIT data access



DATA › EMIT OPEN DATA PORTAL

VISIONS: The EMIT Open Data Portal



Coverage and Forecasts | Mission Products | Greenhouse Gases | Other Applications

Coming Soon! As part of EMIT's mission, the science team will be delivering EMIT 10 minerals and fractional cover, along with uncertainties, to the LP DAAC. As our scientists complete reviews of each product, these data will become available (in 2023). We will also provide visual representations of them here for accessibility. Links to download the actual data sets from the LP DAAC will be provided.

https://earth.jpl.nasa.gov/emit//

https://earth.jpl.nasa.gov/emit/news-events/news/?page=0&per_page=40&order=publish_date+desc%2Ccreated_at+desc&search=

EMIT hyperspectral

One of NASA's airborne missions ha
to test EMIT's spectroscopic approac
mineral composition. In the Salton S
California, the Airborne Visible/Infrar
Spectrometer (AVIRIS) instrument c
large data set in the figure below. By
spectrum for every point in the image
successfully mapped the minerals he
goethite, calcite, and kaolinite based
distinct spectral signatures. These a
minerals for the EMIT investigation (
NASA/JPL)

https://www.eoportal.org/satellite-mis
emit#science-objectives

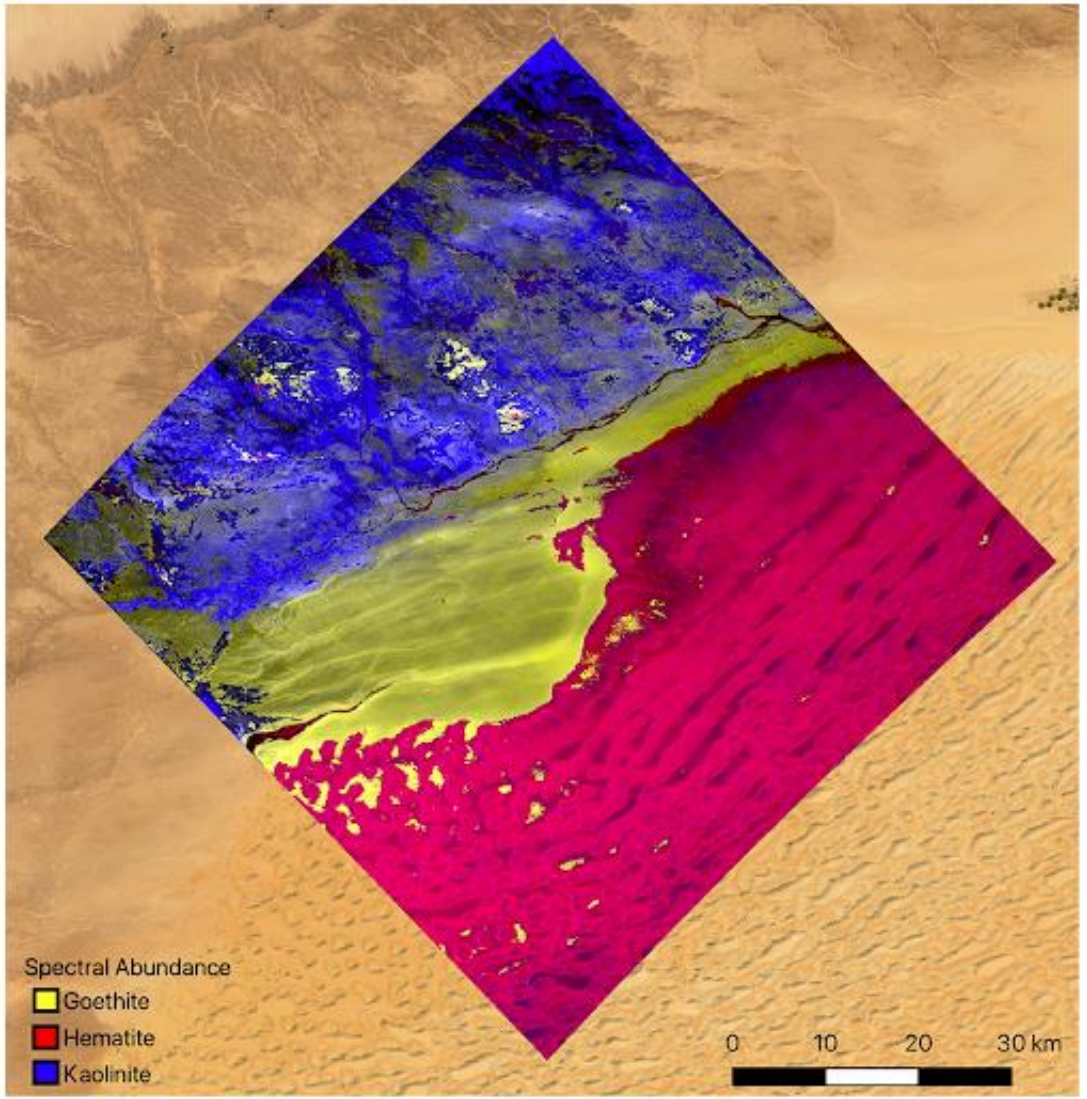
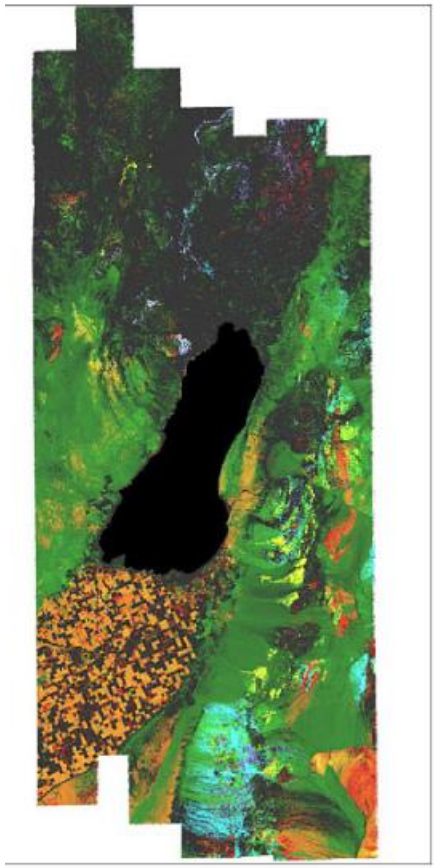


Figure 17: Mineral map of part of South-West Libya, measured by NASA's EMIT instrument. (Image credit: NASA/JPL-Caltech)



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GEO GROUP ON EARTH OBSERVATIONS

Remote Sensing in support of ASGM policy development, implementation and evaluation

06.11.2023

Dr. Abdul-Wadood Moomen

OUTLINE

Background

Methods

Key findings

Recommendations

Background

ARTISANAL AND SMALL-SCALE GOLD MINING

Produces up to **20% of world's gold**

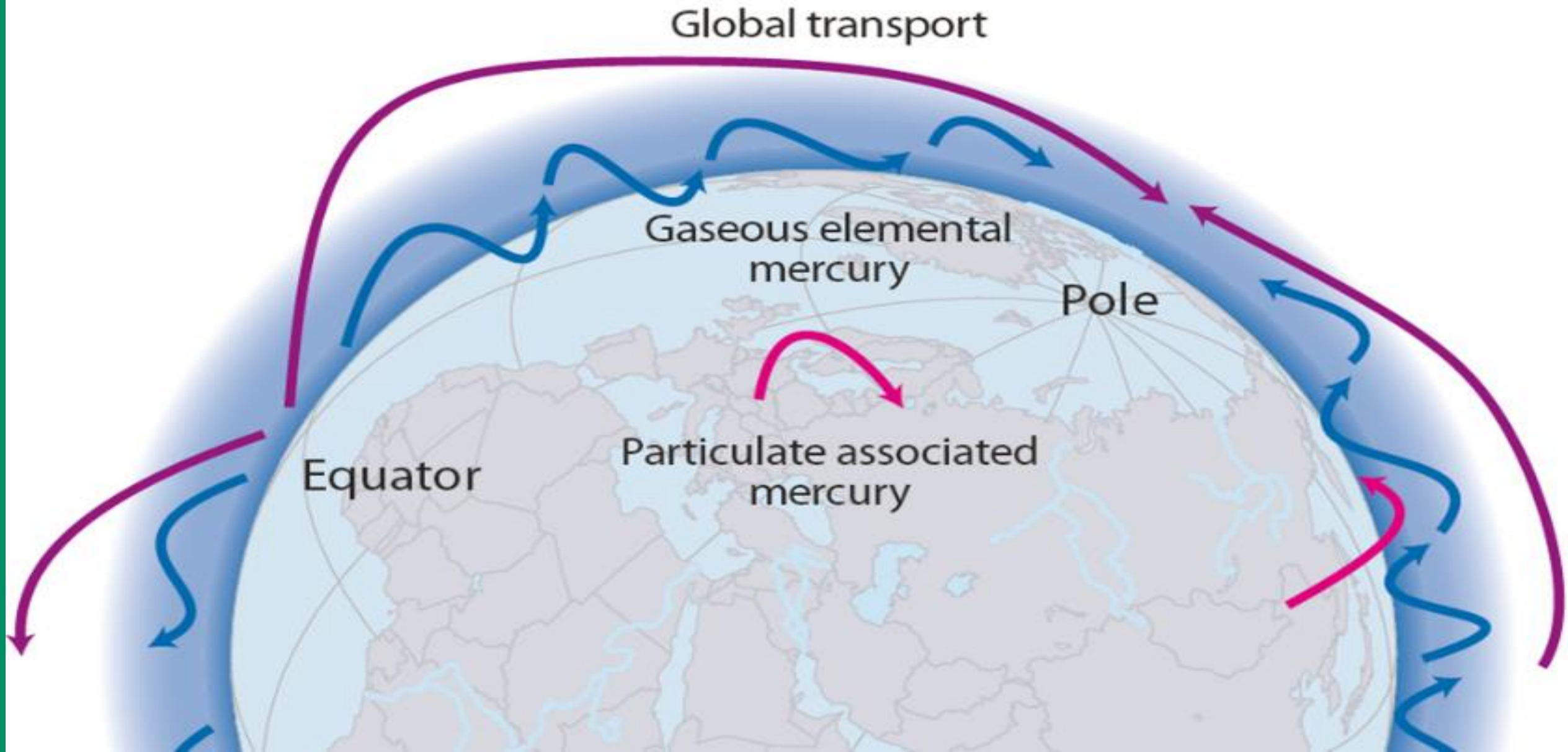
Employs **15 million people** typically in remote **rural areas**

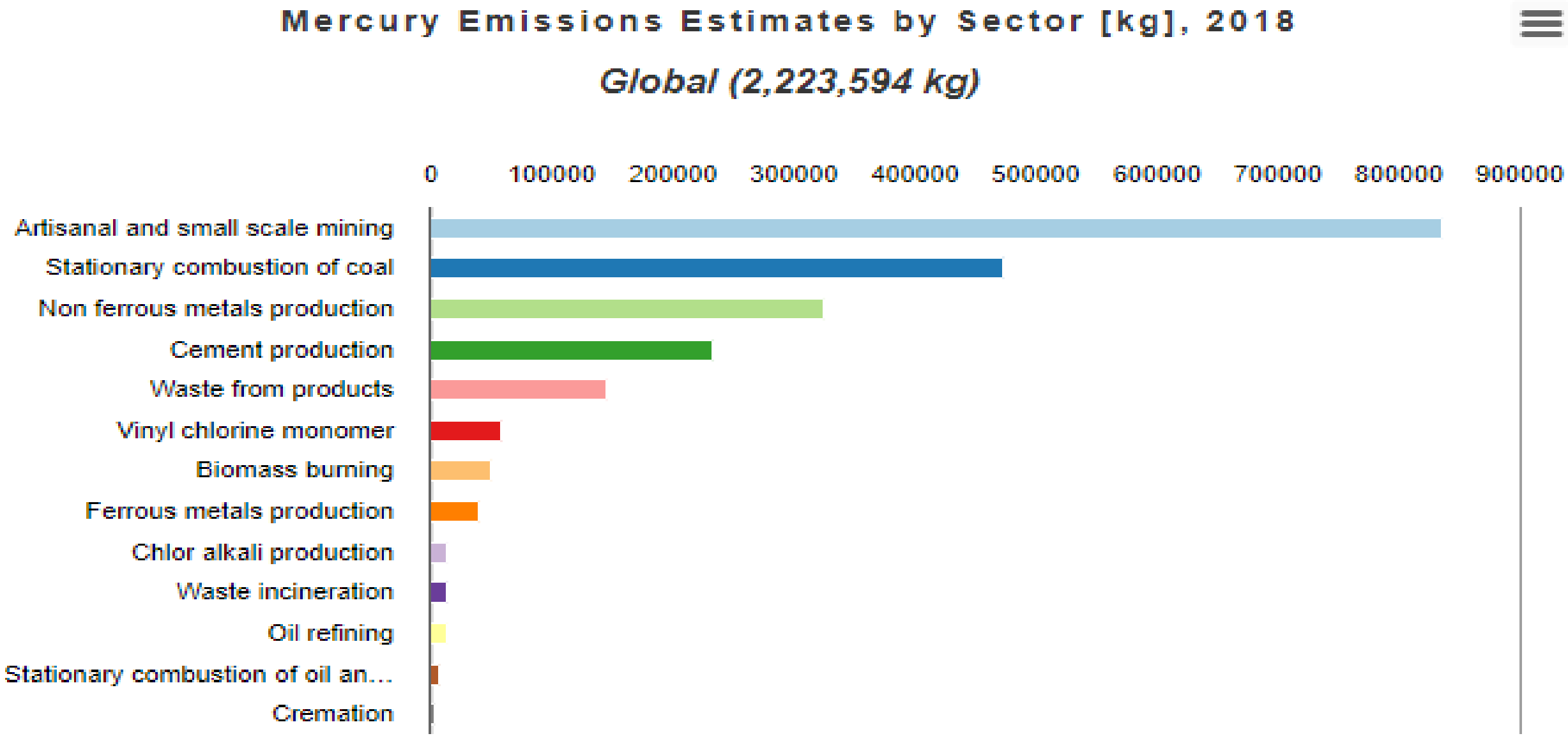
Involves **4 to 5 million women and children**

Takes place in **70 countries** and often in areas where there is **limited economic opportunity**

Releases **35% of all mercury** pollution to the environment

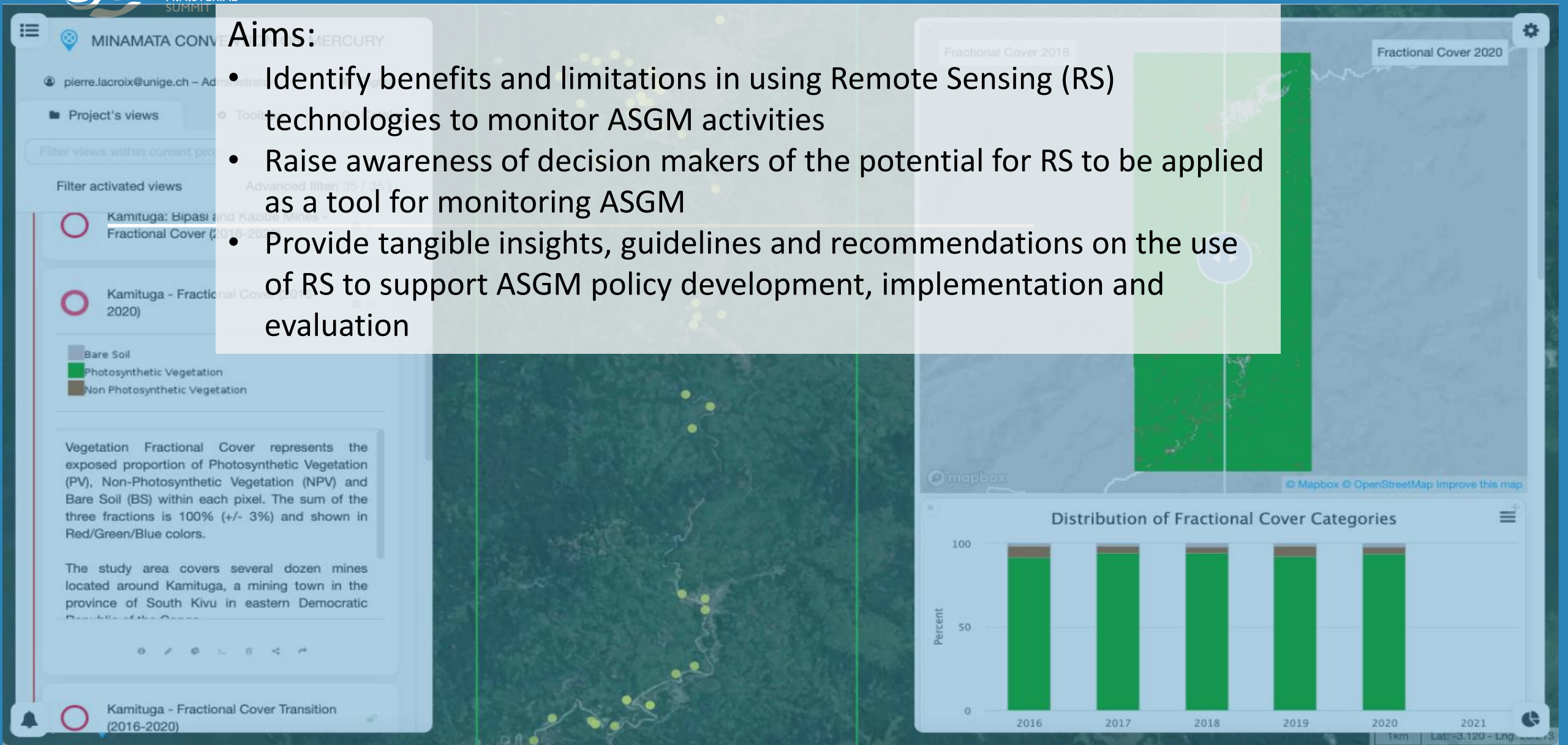
Is often considered as **informal sector**


Global transport
Gaseous elemental mercury
Pole
Particulate associated mercury
Equator


Mercury Emissions Estimates by Sector [kg], 2018
Global (2,223,594 kg)
0
100000
200000
300000
400000
500000
600000
700000
800000
900000
Artisanal and small scale mining
Stationary combustion of coal
Non ferrous metals production
Cement production
Waste from products
Vinyl chlorine monomer
Biomass burning
Ferrous metals production
Chlor alkali production
Waste incineration
Oil refining
Stationary combustion of oil an...
Cremation

Aims:

- Identify benefits and limitations in using Remote Sensing (RS) technologies to monitor ASGM activities
- Raise awareness of decision makers of the potential for RS to be applied as a tool for monitoring ASGM
- Provide tangible insights, guidelines and recommendations on the use of RS to support ASGM policy development, implementation and evaluation



Key findings (benefits)

1. Identification of key benefits of using RS for ASGM monitoring
   - In terms of analysing large areas
   - Analysing back in time
   - Analysing inaccessible/remote areas
   - Scalability
   - Combining multispectral information (optical and radar)
   - Integrating RS results with other geographical or in-situ data in GIS software to understand correlations between different factors
   - In terms of the increasing availability of processing platforms, pre-processed data and available tools
   - Land use/land cover methods applied to ASGM will likely increase their accuracy and ease of use through time
   - Same for RS data spatial and temporal resolution

2. Limitations of using RS (non technical)

- Technical competences are present in scientific communities but not always in policy agencies and governmental agencies

- Technical competences are not always present in local mining associations and local communities, decreasing their involvement in the monitoring process and the policy development. This can sometimes undermine local trust and inflame tensions

- RS technology used for environmental surveillance purposes can lead to “crime mapping” and enhance socio environmental disputes

3. Identification of 15 key technical limitations of using RS (annex)
4. Development of a set of guidelines for ASGM practitioners who want to start with the use of RS (annex)
5. Implementation of 4 case studies using RS tools to monitor ASGM impacts on the environment (annex)
   - In Eastern DR Congo, Peru, Colombia
   - For monitoring land cover change and water turbidity
   - Using Open Data Cube and Google Earth Engine
   - Dissemination on MapX
6. Recommendations for different typologies of users
   - Researchers
   - International organizations and funders
   - Data and software providers
   - Governments officials and policymakers in ASGM countries

Recommendations for governments/policymakers

- Include GIS and RS tools in programmes related to ASGM policy development
- Integrate with local knowledge
- Solicit the know-how from local universities
- Build capacity among local universities lacking technical knowledge
- Encourage multi-disciplinarity, e.g. combine RS outputs with other information (social, health, conflicts, demography)
- Involve local communities and mining associations in the elaboration of ASGM policies and programmes
- Disseminate RS outputs on cartographic media to make them understandable by a non technical audience
- Pay attention to crime mapping

Thank you for your attention

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Photos: the negative impacts of informal ASGM on river networks in Ghana.

Left: pollution of the Pra River. *Right: pollution of the Ankobra River*

Partners and Affiliations

UN environment programme

UN environment programme GRID Geneva

MINAMATA CONVENTION ON MERCURY

UENR University of Energy and Natural Resources

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MINEYE

Earth Observation techniques for MINe lifE cYclE monitoring using ML-based data fusion approach

Project duration: 2024-2028

irene Benito, Planet

+ PNO PNO GROUP

MINEYE

MINEYE Consortium

NGI · Alma Mater Studiorum A.D. 1088 · Luleå University of Technology

etam s.a. consulting services · TRE ALTAMIRA A CLS Group Company · T. · planet.

Česká geologická služba 1919 · INNSIGHT · SPECTRAL INDUSTRIES · SPACEBEL

Demo sites

THARSIS MINING

Tharsis - Spain

SO.RI.CO.M. Srl
SOCIETA' RICERCHE COLTIVAZIONI MINERARIE

Soricom

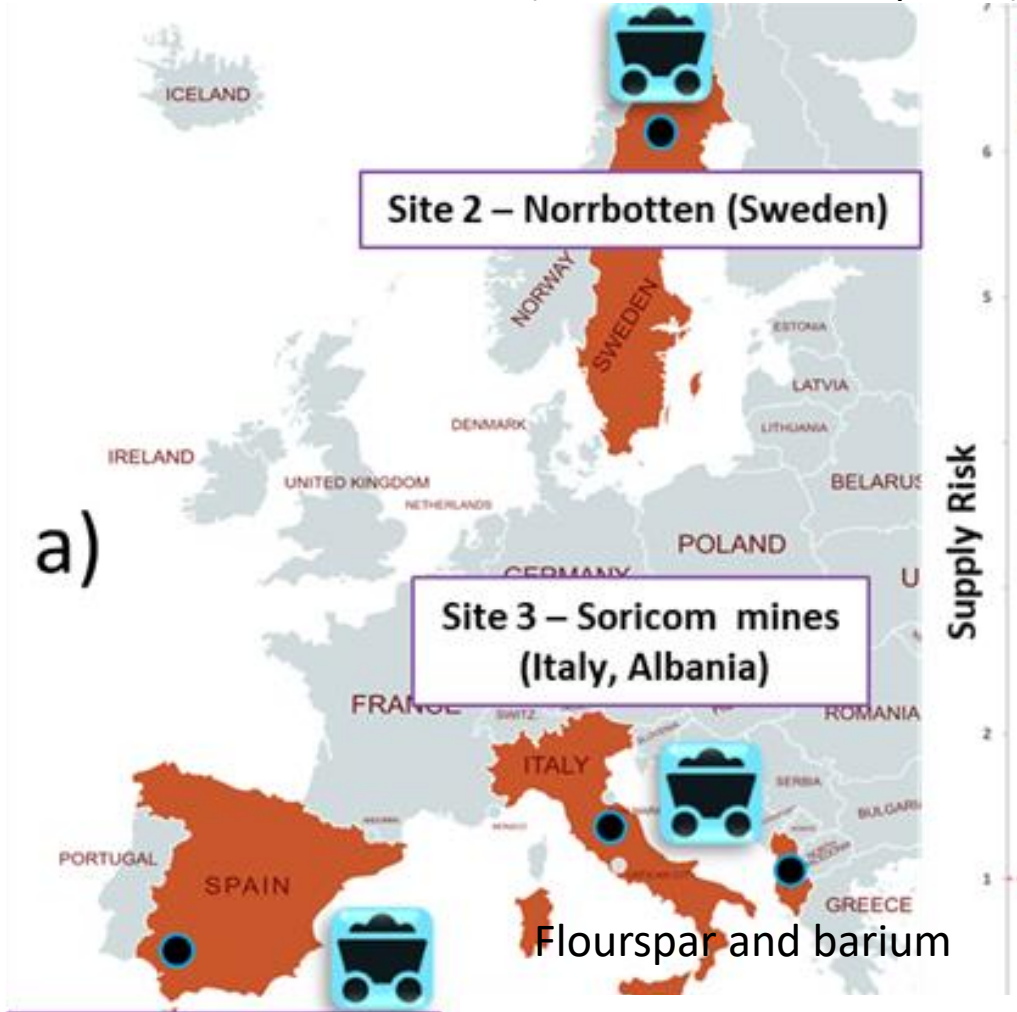
- **2 Universities**
- **2 Research institutes**
- **2 Demonstration sites**
- **4 SME or medium businesses**
- **3 Large Businesses**

MINEYE OBJECTIVES

- To develop a web-interface for better integration of existing and newly collected EO and survey data to optimize operations within the entire mining life cycle
- To turn mining wastes to extractable materials meanwhile reducing mine tailings environmental footprints at local and global scales, and secure mine safety during mineral extraction
- Demonstrate the technologies in different case studies covering the whole value chain to validate the applicability and replicability of the MINEYE technologies in various mining contexts of relevance (exploration of yet-to-be exploited areas, secondary mining, revalorization of historical mines)
- To ensure knowledge sharing and uptake to maximize impacts

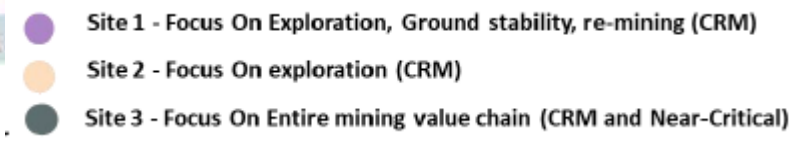
Demo sites and significance of their deposits

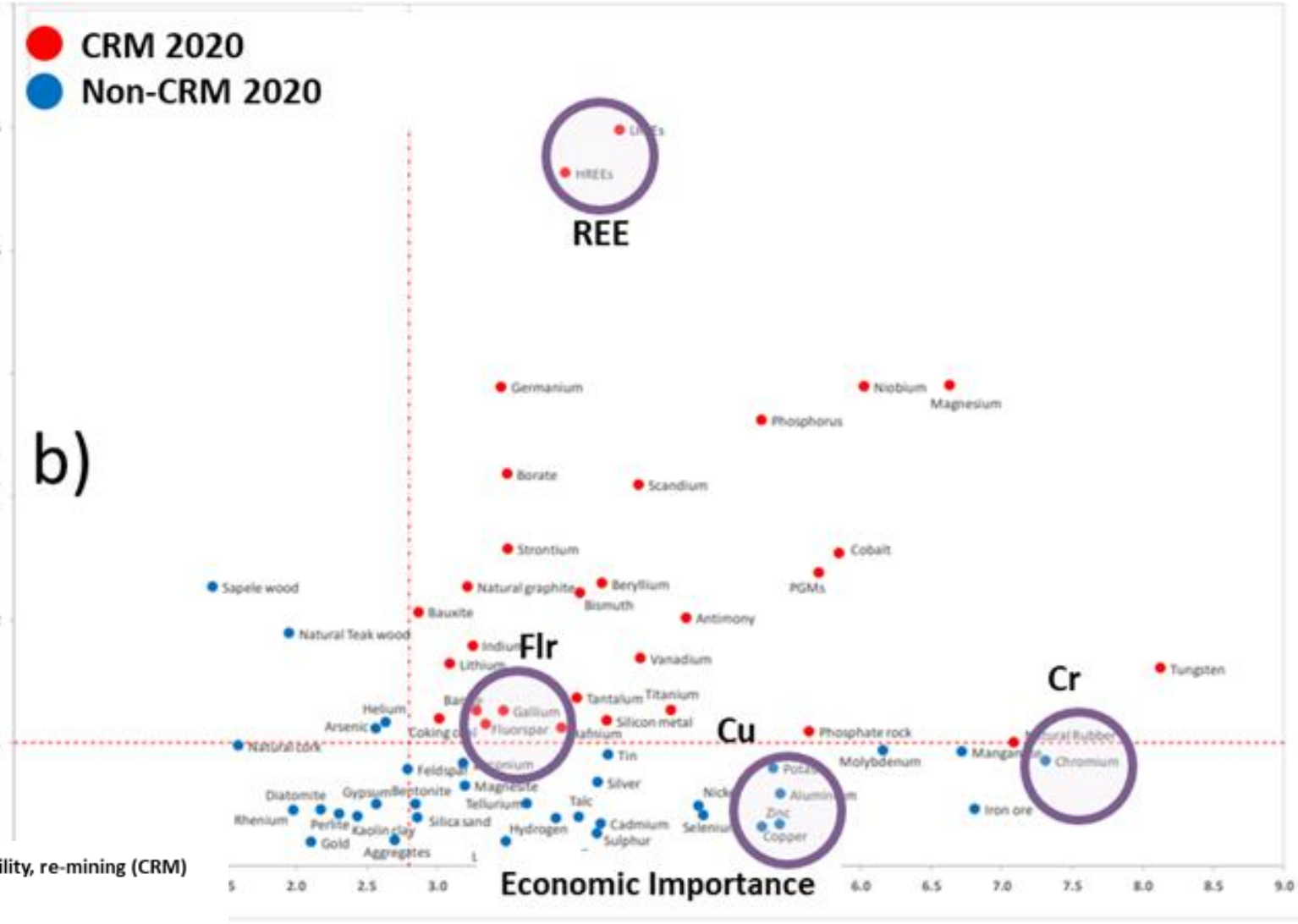
CRM (REE carbonatite, apatite)



Flourspar and barium

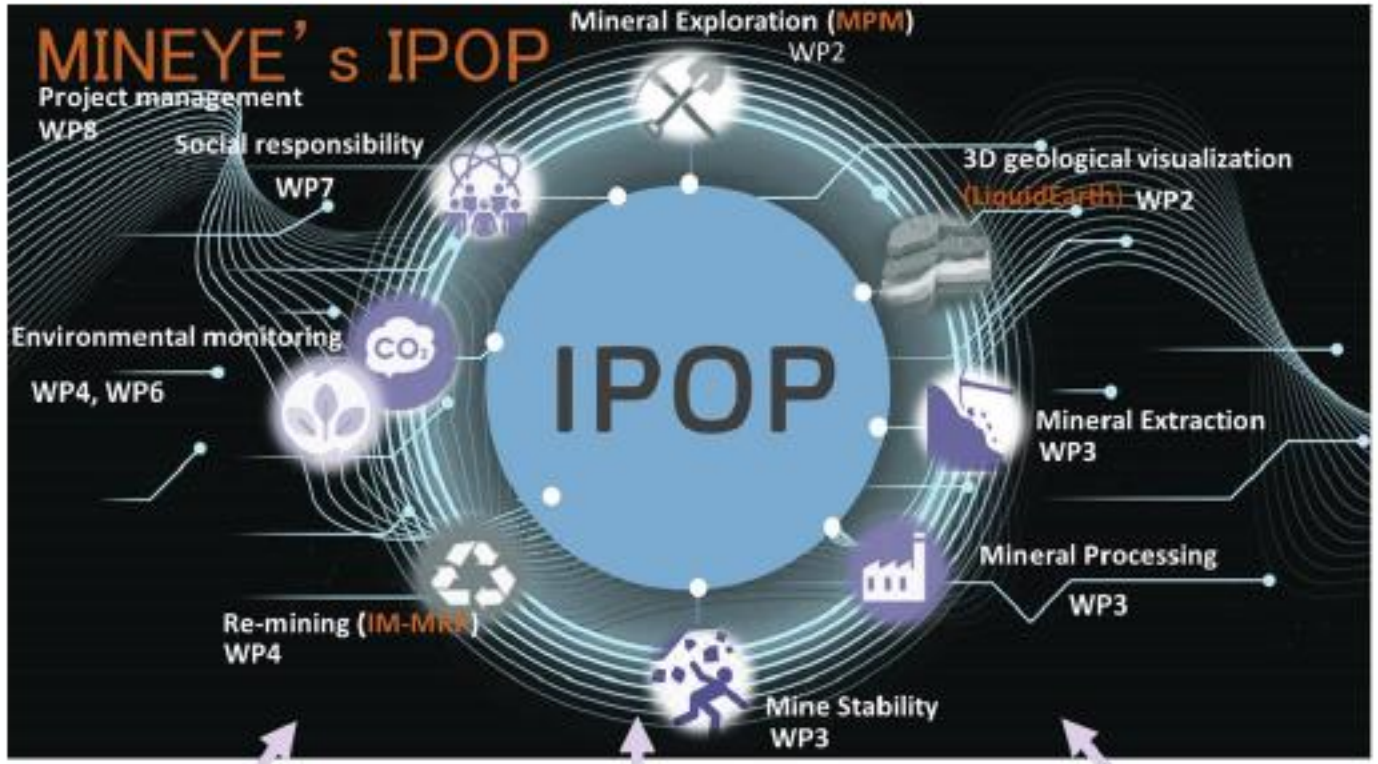
VHMS, skarns, IOCG





Three demonstrations sites for the MINEYE project, all with focus on CRMs two of which covering full mining life cycle of exploration, mineral extraction, ground stability, mine tailing and re-mining potential studies. b) Criticality assessment results (individual materials and groups) for Chromium (EC report 2020)

MINEYE's Interfacing, Programming and Optimization Platform (IPOP)



Impacts

Sustainable and green mining

- High-suscess rate for explorations
- Safer mining operations
- Digital mining operations
- Less generated waste from mineral processing
- Maximized utilization of existing data
- Socialy responsible mining
- Environmental friendly mining

Site 1 – Tharsis Cu (Spain)

Site 2 – Norbotten REE (Sweden)

Site 3 – Soricom mines Fr and Cr (Italy and Albania)

- Site 1 - Focus On Exploration, Ground stability, re-mining (CRM)
- Site 2 - Focus On exploration (CRM)
- Site 3 - Focus On Entire mining value chain (CRM and Near-Critical)

What will Planet do?

Data fusion PlanetScope and Tanager and testing for:

- Monitoring the environmental impact of mining residues
- Mineral mapping (secondary raw minerals, mineral prospectivity maps)

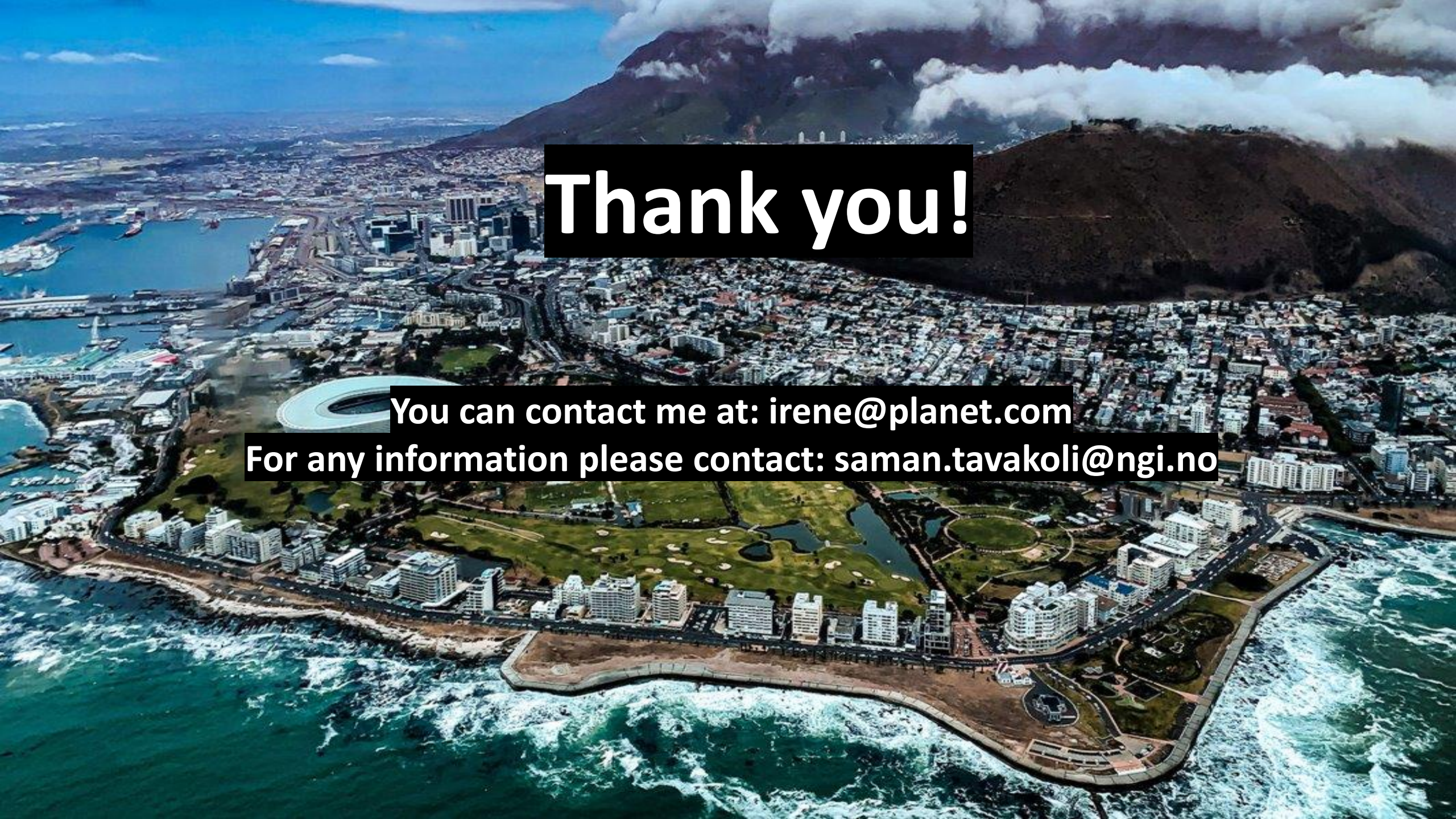
Outcomes

The outcomes of the MINEYE project are very much aligned with the pillars of the recent Critical Raw Material act, as the project proposes a tool for more efficient and sustainable mining practices.

As outlined in the Strategic Implementation Plan of the EIP on Raw Materials, the establishment of a network of research, education and training centres as well as the sharing of best practices within the EU will have a positive impact on the development of disruptive solutions to the challenges of the European mining industry.

The MINEYE project will participate in creating methodologies, best practices and standards to help policy makers harmonize mining practices and sustainability expectations across Europe.

Resulting optimization of mining activities will thus reduce import dependency and i**ncrease autonomy in key strategic value chains** that depend on a secured supply of critical material. The MINEYE project will demonstrate it for several CRMs and SRMs but could be applied to all CRMs.


Thank you!
You can contact me at: irene@planet.com
For any information please contact: saman.tavakoli@ngi.no

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6-10 NOVEMBER

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Thank you!