The role of Geological Surveys into GEOSS and Copernicus

Gerardo Herrera

Earth Observation and Geohazards Expert Group

Summary

1. Earth Observation and Geohazards Expert Group
2. Earth Observation for Raw materials
   - Geological mapping
   - Mineral mapping
   - Mining monitoring
3. Potential research and development needs
4. EGS community building

1. Earth Observation and Geohazards Expert Group

Mission and vision

28 GSs

- **Apply Earth Observation technology** to improve geoscience delivery on **geohazards** and **raw materials lyfe cycle**
- Deliver harmonized Earth Observation based geo-information improving the operational capacity and economic capabilities of governments, institutions, organizations, businesses and individuals.

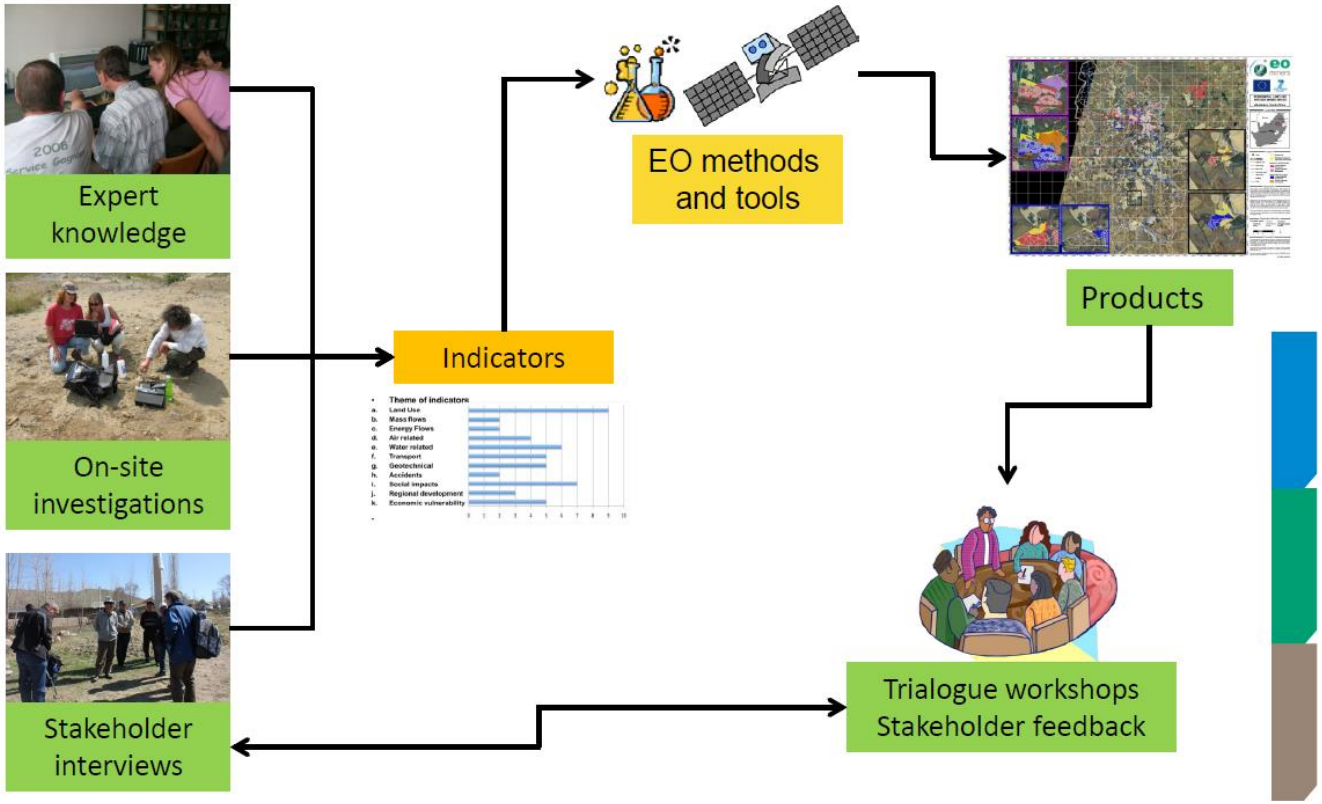
2. Earth Observation and Geohazards Expert Group

Working groups:

- Geohazards: subsidence and landslide WG
  - Leaded by Gerardo Herrera (IGME), g.herrera@igme.es
- **Earth Observation and Exploration WG**
  - Leaded by Veronika Kopackova (CGS), Veronika.Kopackova@seznam.cz

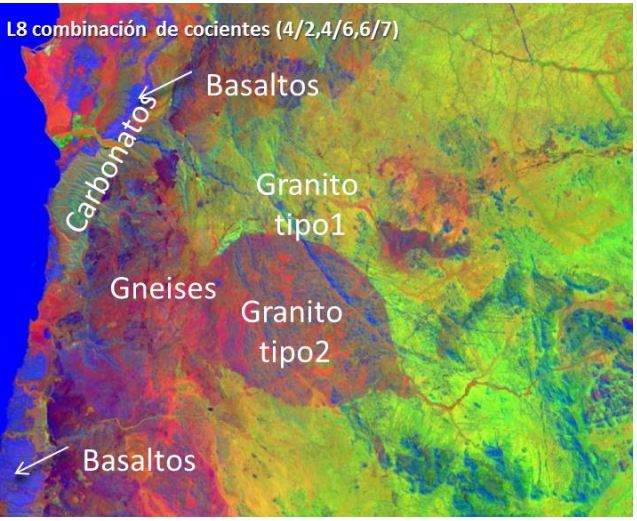
3. Earth Observation for Raw Materials

EGS applies and develops EO-based methods and tools to improve the interaction between the mineral extractive industry and society for its sustainable development while improving its societal acceptability.



Geological mapping

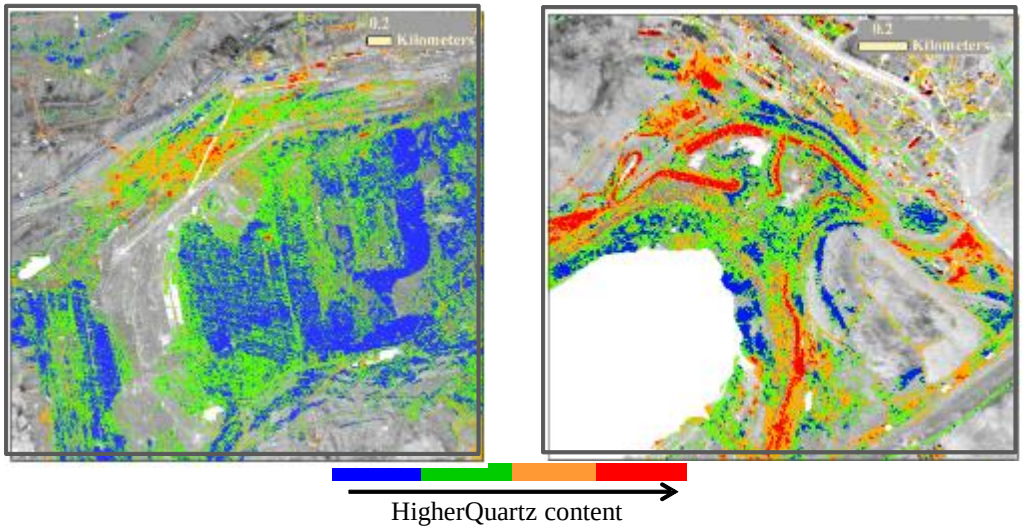
Angola Geology map

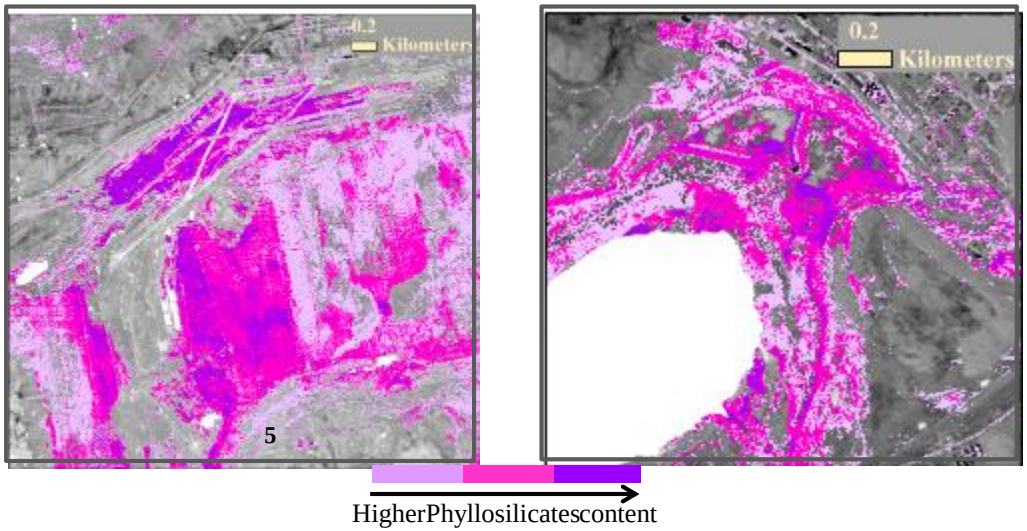


Mineral mapping

Mineral thematic map showing surface geological materials from hyperspectral data

Sokolov Lignite Open-Pit Mines, Czech Republic

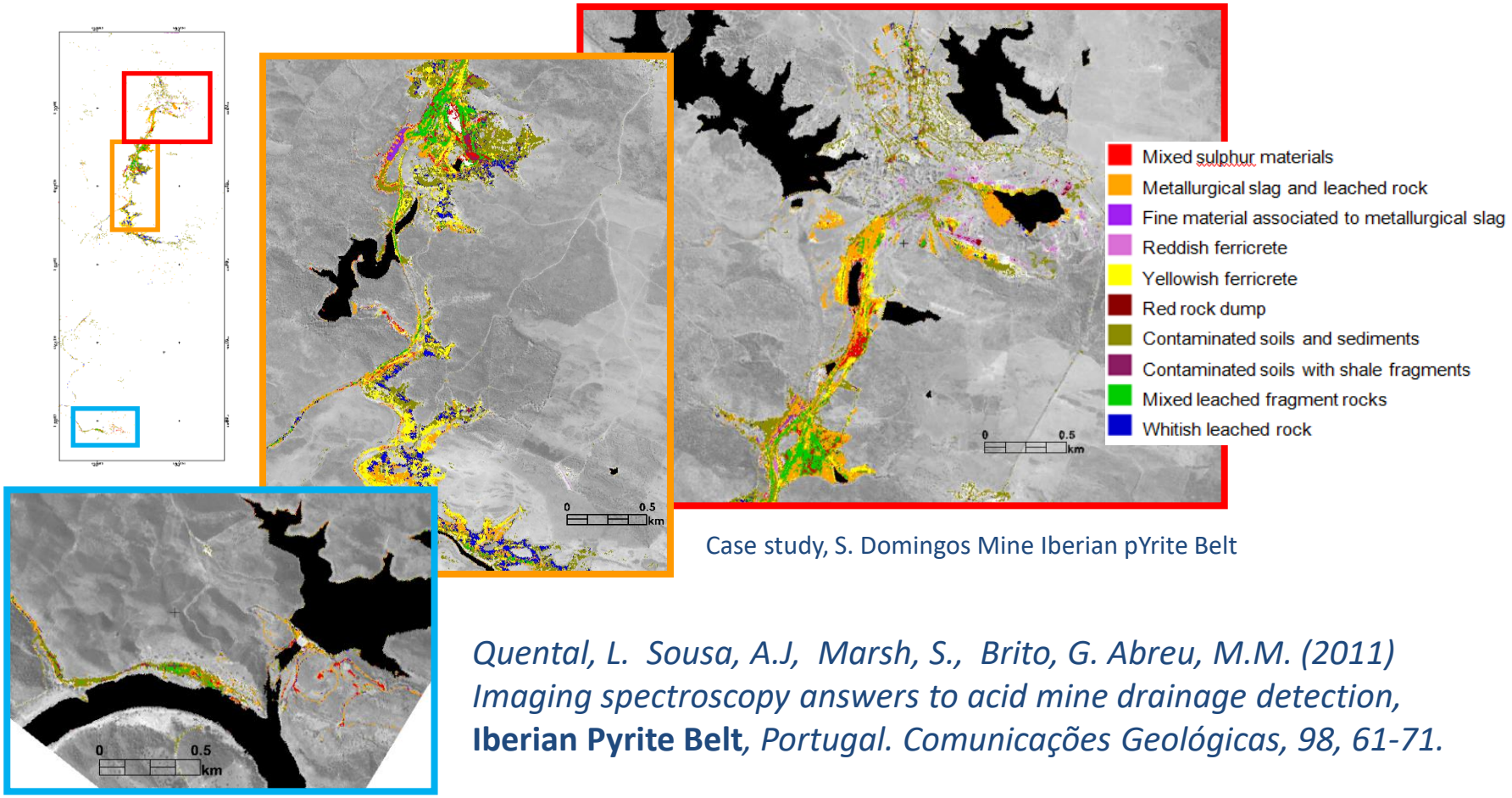




Notesco, G. – Kopačková V. – Rojík, P. – Schwartz, G. – Livne, I. – Ben-Dor, E. (2014): Mineral Classification of Land Surface Using Multispectral LWIR and Hyperspectral SWIR Remote-Sensing Data. A Case Study over the Sokolov Lignite Open-Pit Mines, the Czech Republic. – Remote Sensing 6, 8, 7005-7025. ISSN 2072-4292 (on line). DOI 10.3390/rs6087005.

Mineral mapping: Acid Mine drainage

Mining waste mapping derived from hyperspectral data and field meaurements

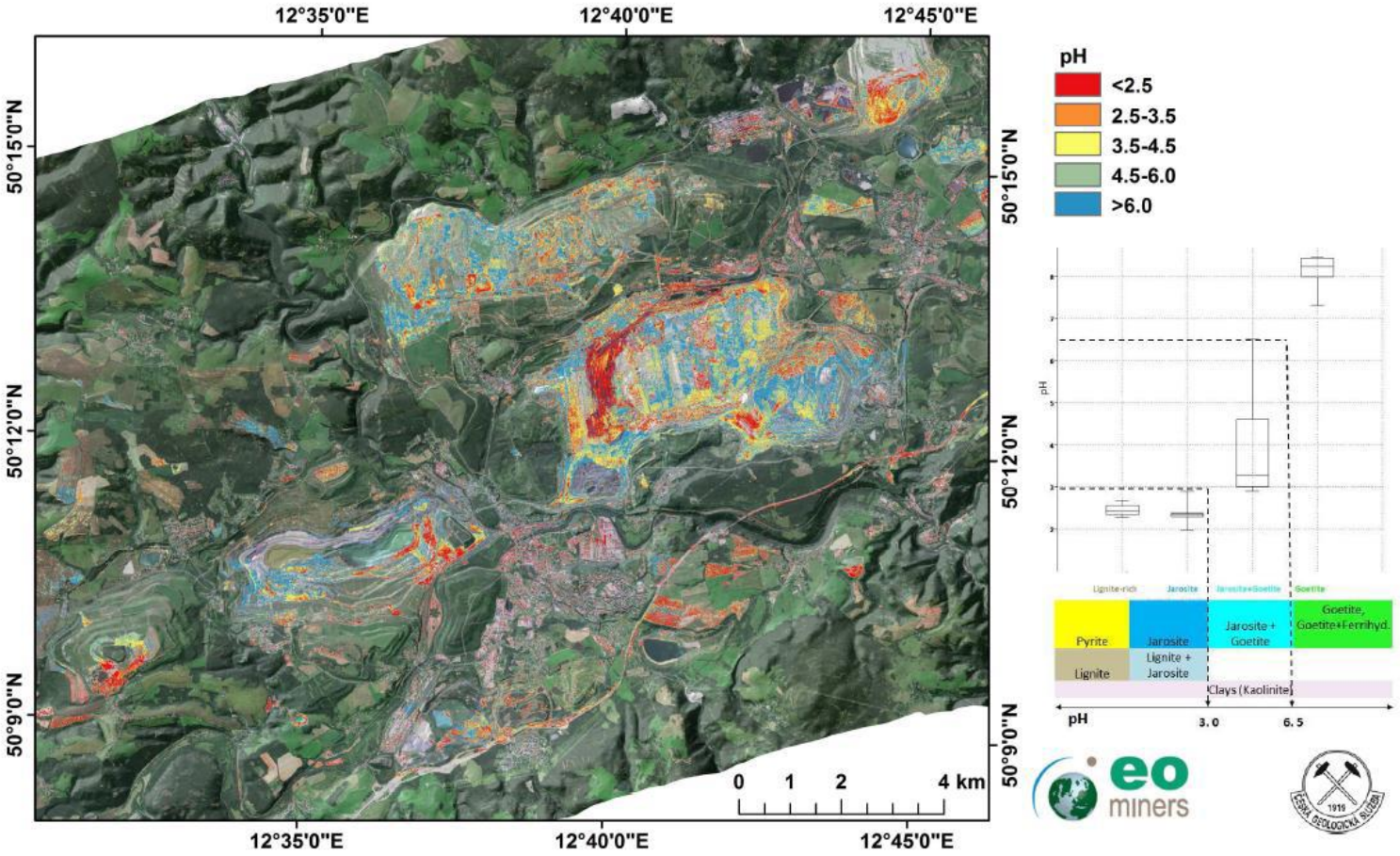


Case study, S. Domingos Mine Iberian pYrite Belt

Quental, L. Sousa, A.J, Marsh, S., Brito, G. Abreu, M.M. (2011) Imaging spectroscopy answers to acid mine drainage detection, **Iberian Pyrite Belt**, *Portugal. Comunicações Geológicas, 98, 61-71.*

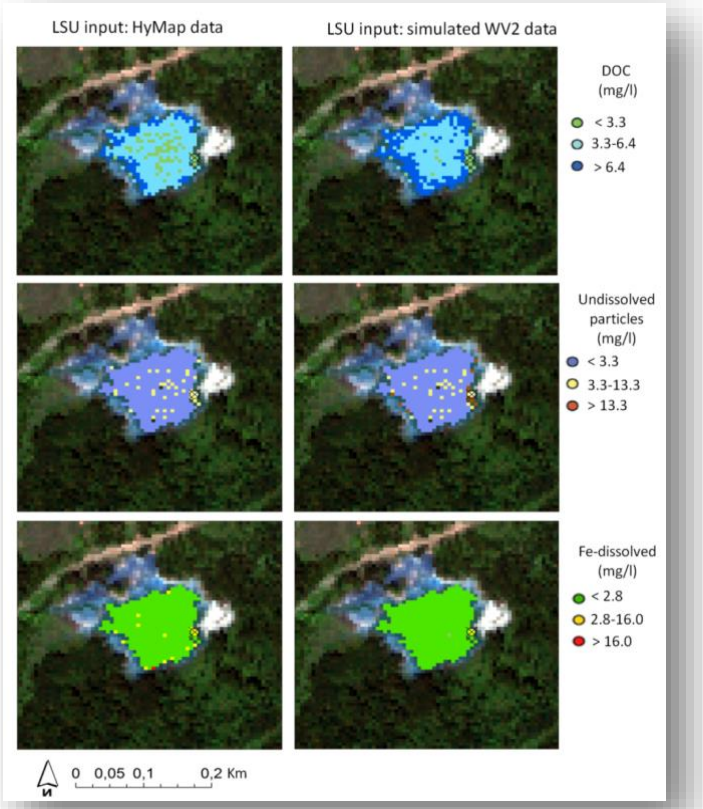
Mineral mapping: quantitative pH evaluation

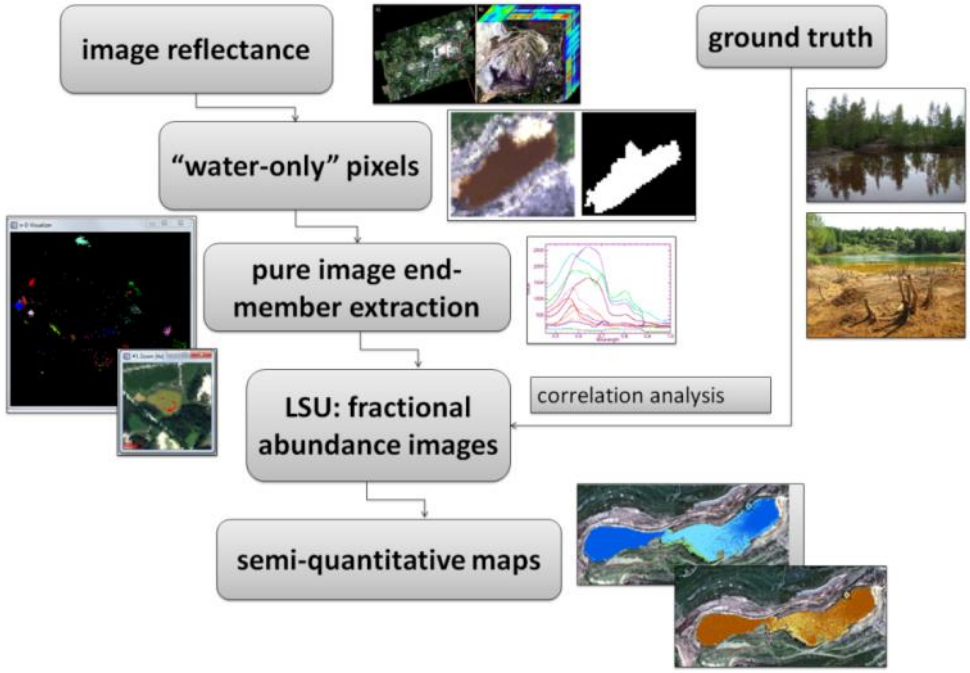
Soil pH map derived from mineral association using hyperspectral imagery



Mineral mapping: surface water mineral content

Mapping surface water parameters from hyperspectral and HR optical satellite (Worldview 2)

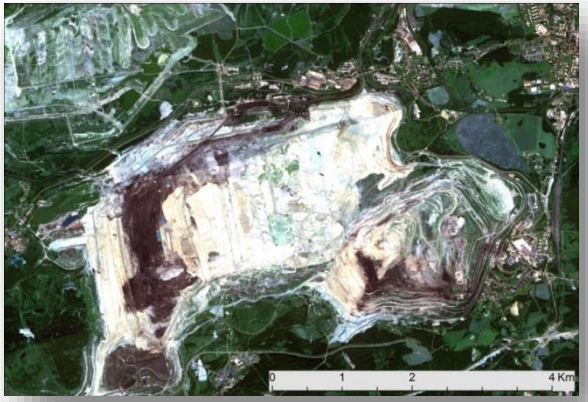


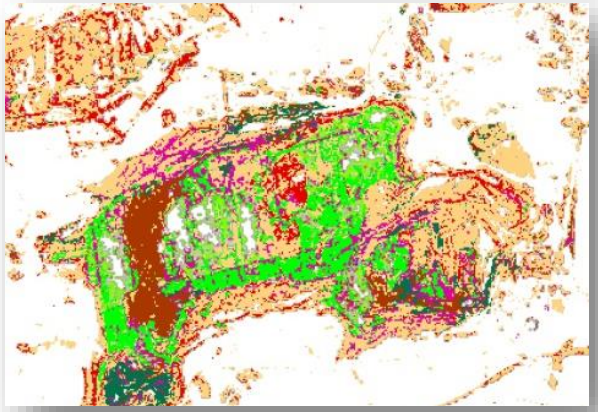


Kopačková V. – Hladíková, L. (2014): Applying Spectral Unmixing to Determine Surface Water Parameters in a Mining Environment. – Remote Sensing 6, 11, 11204-11224. ISSN 2072-4292. DOI 10.3390/rs61111204.

Mineral mapping: Sentinel-2 evaluation

Sentinel-2 data preliminar evaluation for mineral mapping – partially successful





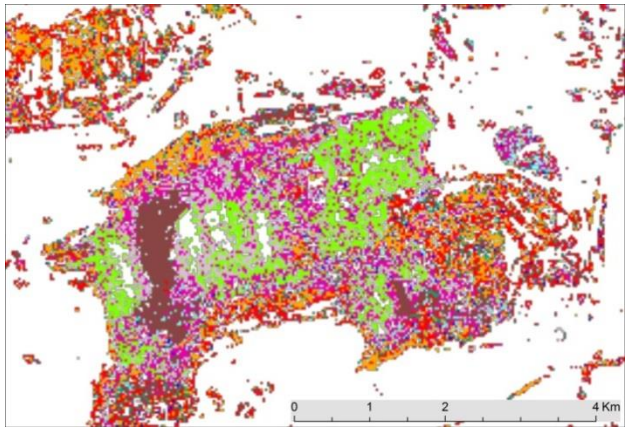
1st derivative analysis

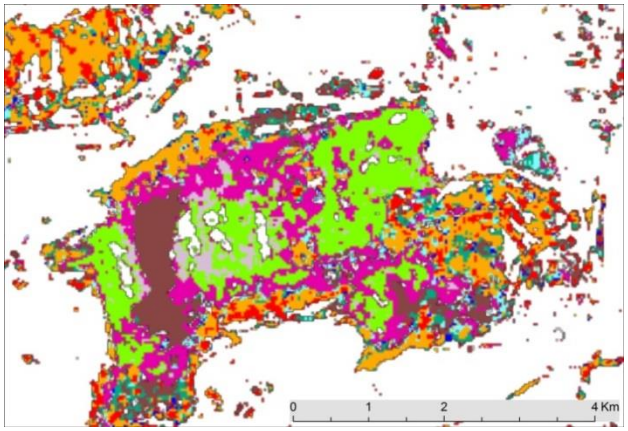
- tuffs, claystones
- lignite
- tuffs, claystones (iron oxides)
- kaolinite
- tuffs, claystones (jarosit)
- tuffs, claystones with lignite

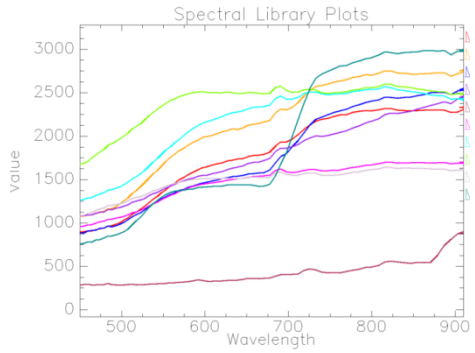
Mineral mapping: EnMAP simulation

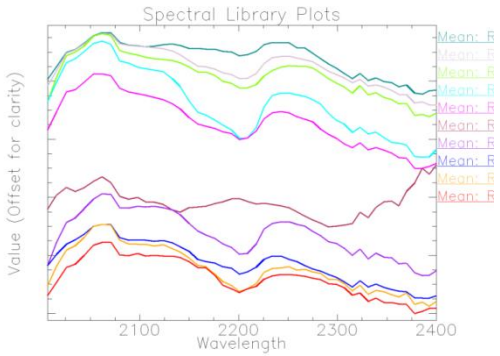
Simulation of EnMap data to test mineral mapping potential of the future hyperspectral satellite - EnMap

- tuffs enriched in jarosite
- kaolinized tuffs
- clays (iron-bearing minerals and lignite)
- kaolinized tuffs with lignite
- claystones rich in ferric minerals
- lignite
- cypris clays mixed with lignite
- kaolinite (fresh)
- weathered claystones







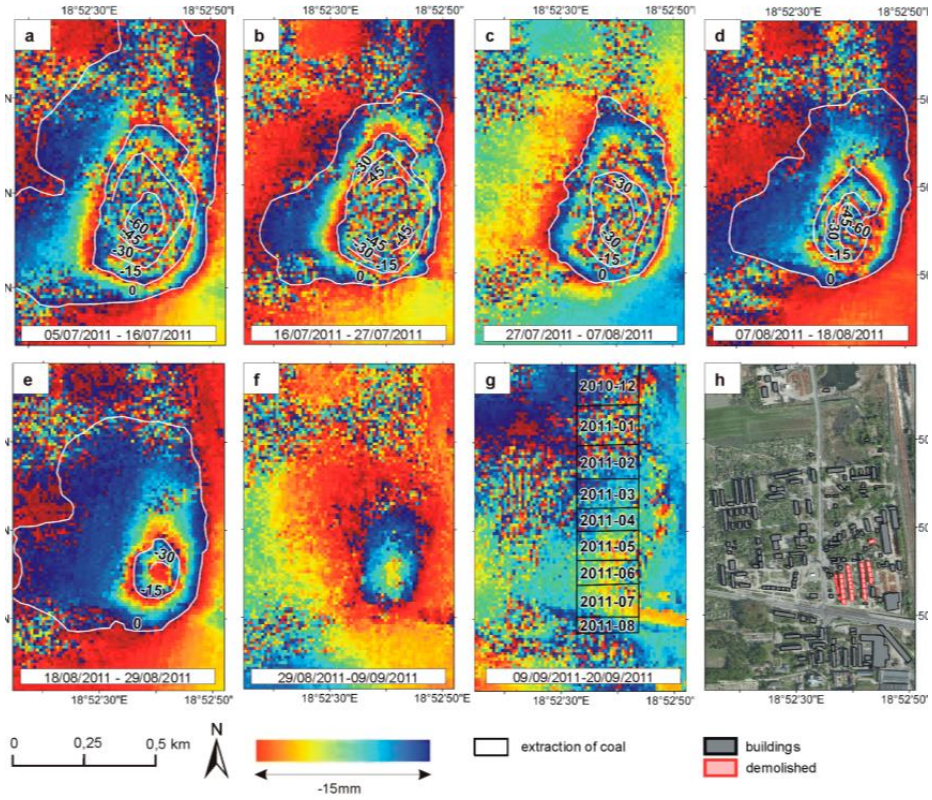


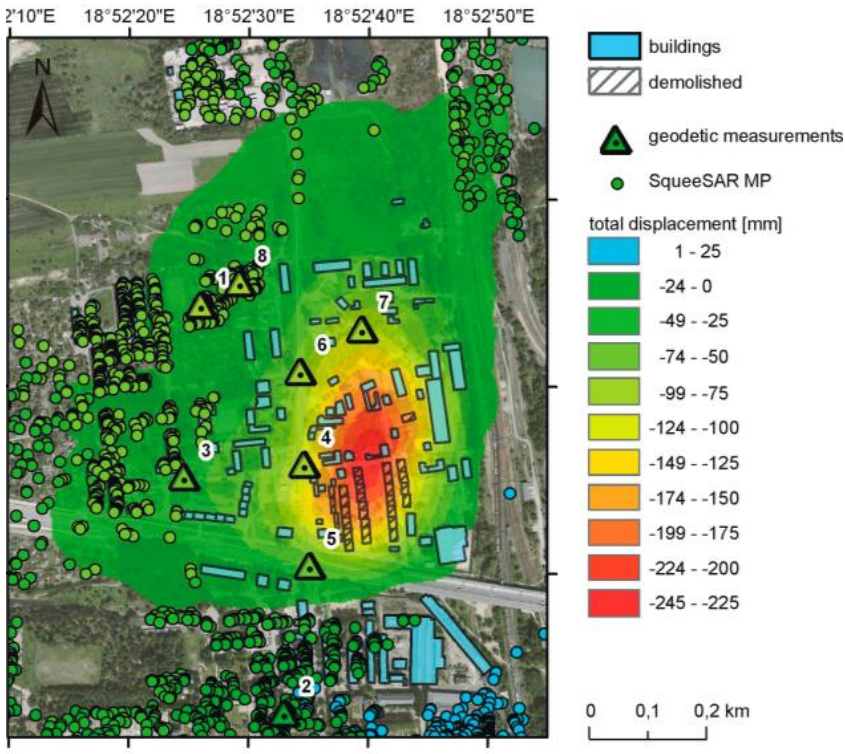
4. Potential reseach and development needs

- Mineral mapping:
  - developping models for quantitative assessment of physical and chemical surface properties (mines, post-mining areas, remediation's) using Sentinel-2 and EnMap satellite data
  - Building a world-wide mineral/rock/soil reflectance and emissivity libraries

Mining monitoring: InSAR

Detection of underground coal mining subsidence in urban areas using Radar Interferometry: USCB (Poland)



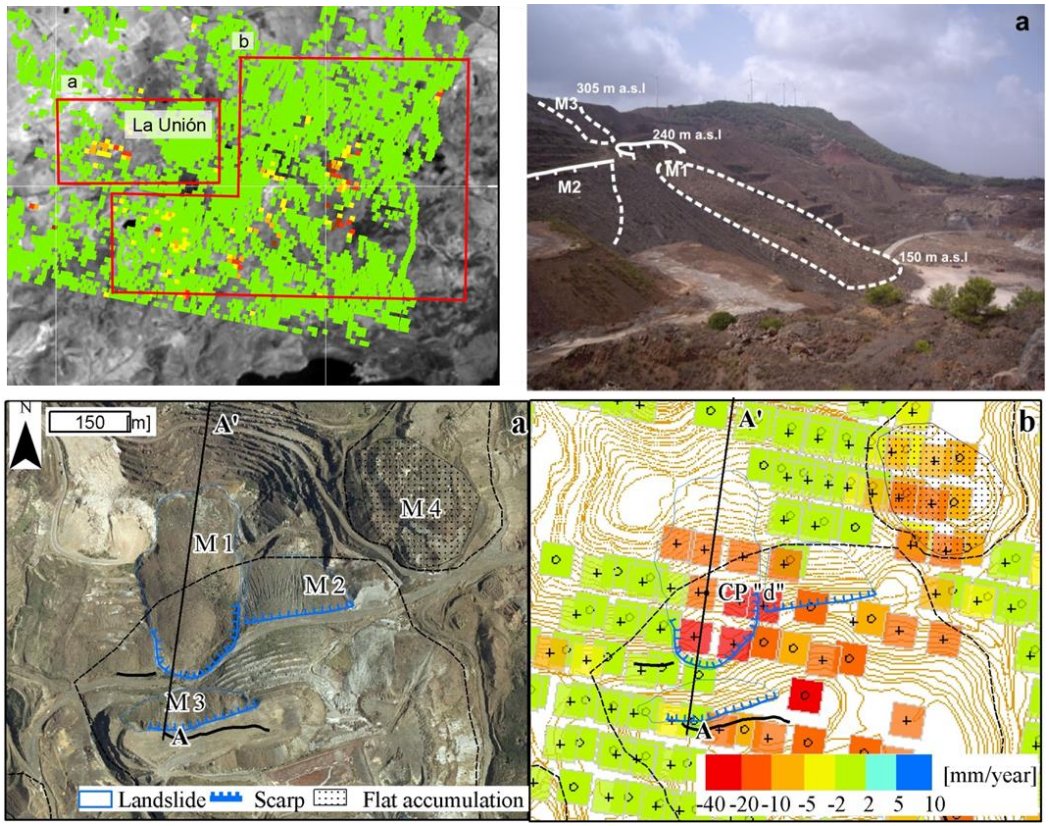


Przyłucka, M.; Herrera, G.; Graniczny, M.; Colombo, D.; Béjar-Pizarro, M. Combination of Conventional and Advanced DInSAR to Monitor Very Fast Mining Subsidence with TerraSAR-X Data: Bytom City (Poland). Remote Sens. 2015, 7, 5300-5328.

Mining monitoring: tailing dumps instabilities

Instituto Geológico y Minero de España

Detection and monitoring of ground instabilities related to mining tailing dumps based on satellite radar interferometry



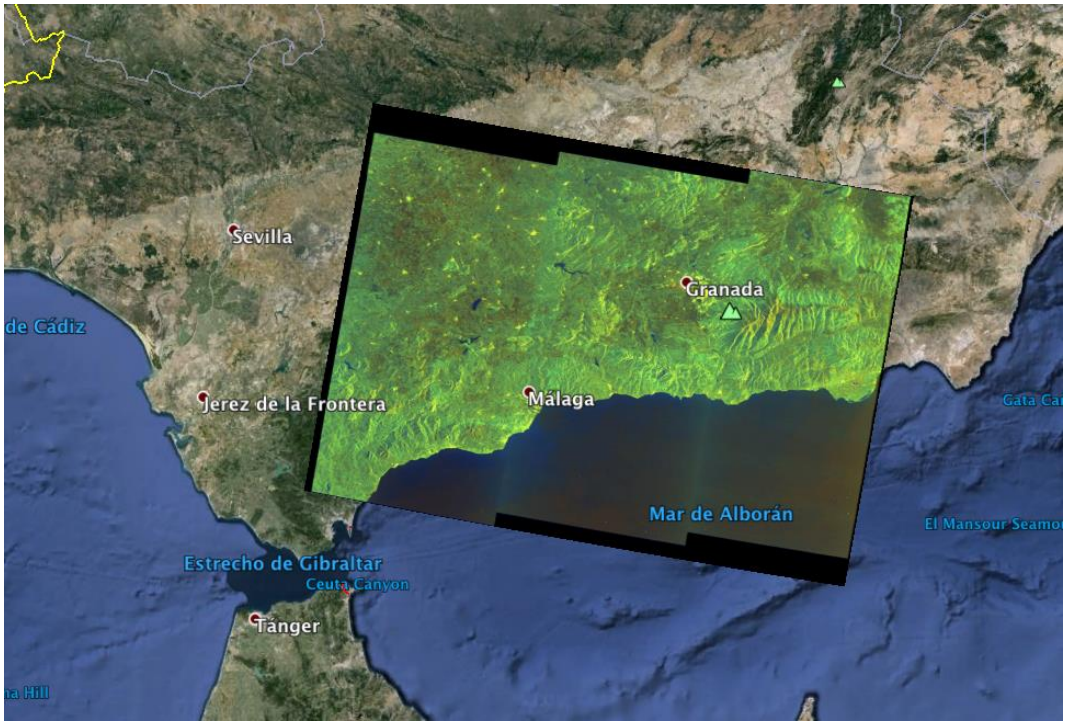
Herrera et al. Mapping ground movements in open pit mining areas using differential SAR interferometry. *International Journal of Rock Mechanics and Mining Sciences*, 2010, vol. 47, no 7, p. 1114-1125.

EuroGeoSurveys The Geological Surveys of Europe

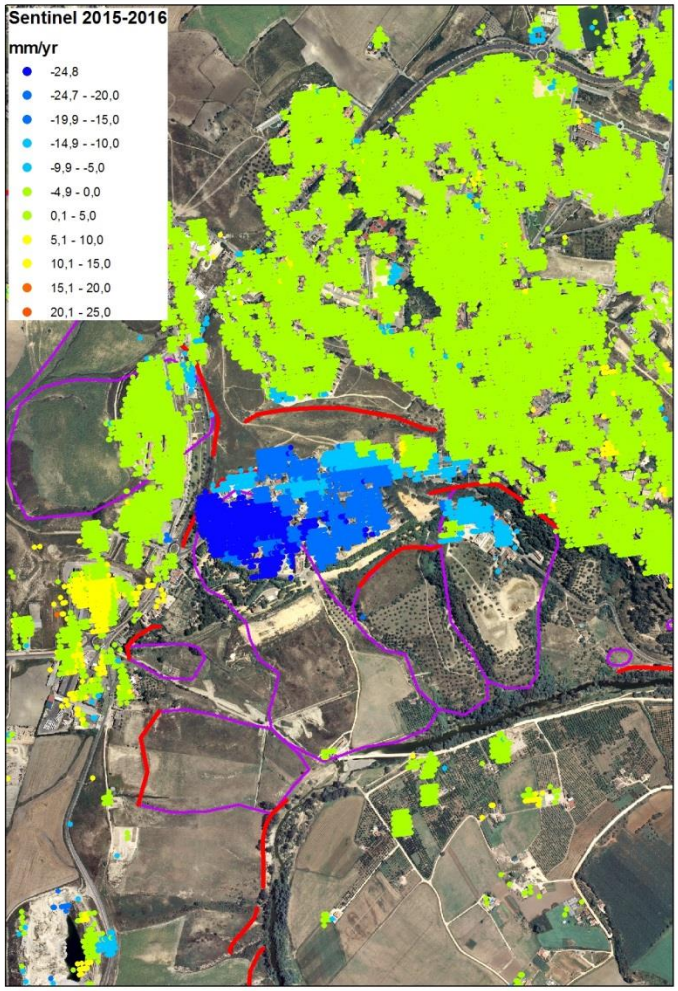
Mining monitoring: Sentinel 1 service level

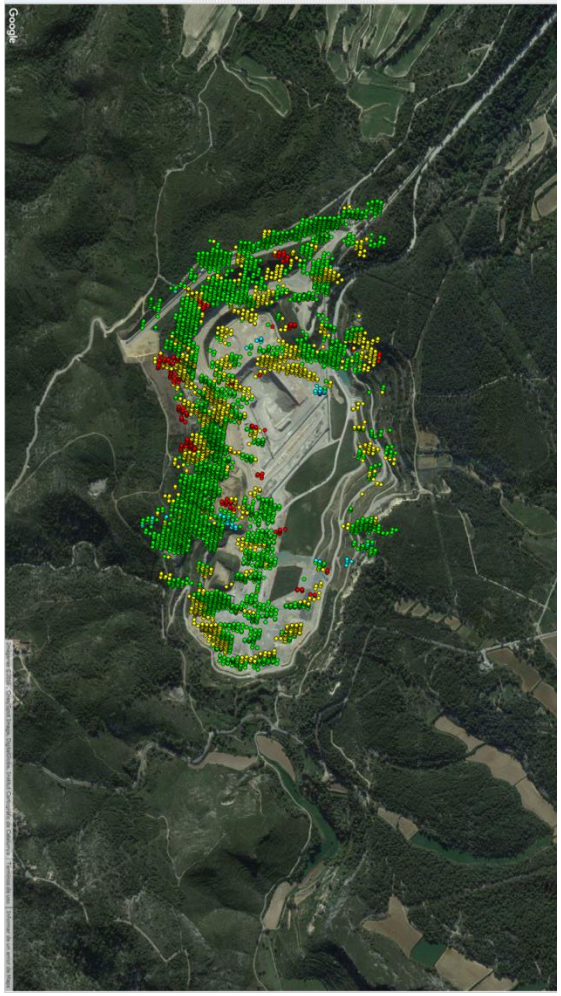
Monitoring mining activity every 12- 6 days is possible

Target: active mines, abandoned mines, mining waste and induced anthropogenic hazards



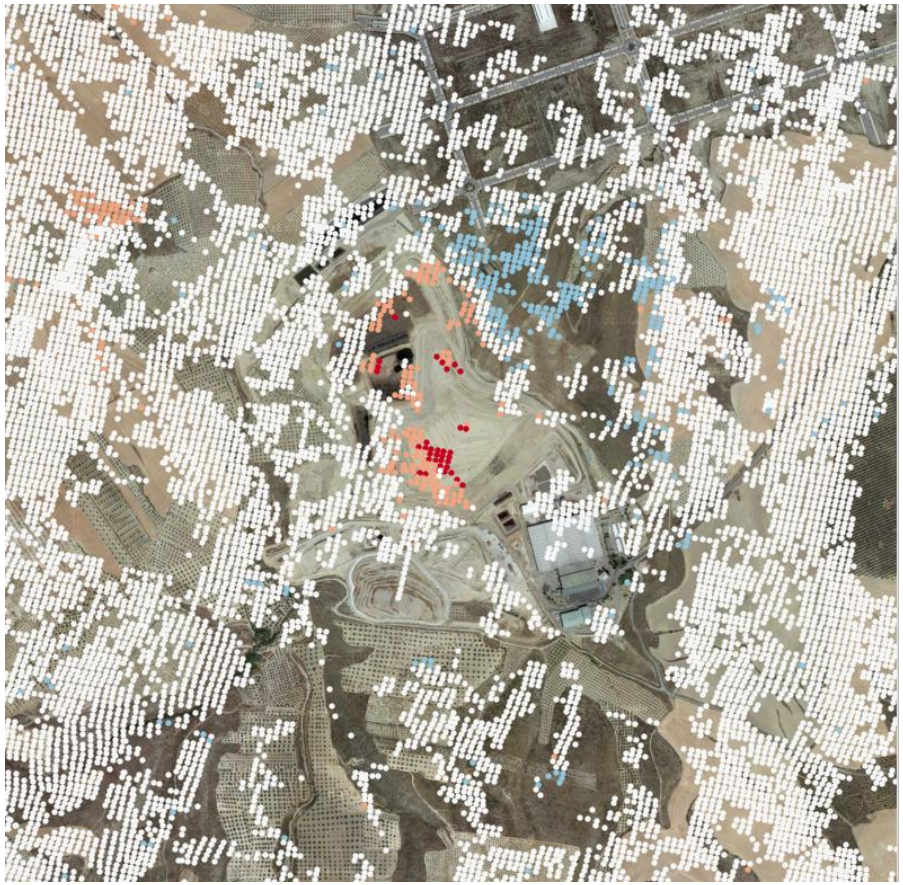
Mining monitoring: Sentinel 1





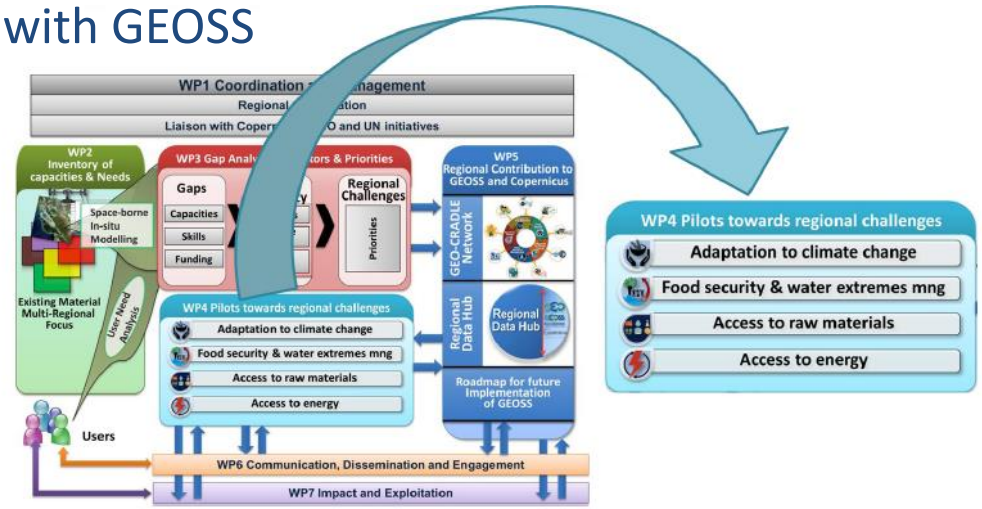
Mining monitoring: Sentinel 1

Acumulated displacement April – November 2015 of a waste dam



GEO-Cradle

Coordinating and integRating state-of-the Art Earth Observation Activities in the regions of North Africa, Middle East, and Balkans and Developing Links with GEOSS



Identification and integrated use of existing regional capacities and skills towards:
(a) long term monitoring of ground deformation during or after mining activities,
(b) mapping of waste materials left over in abandoned mines,
(c) development of an appropriate protocol for the evaluation of the environmental impact, together with feasibility assessment of extractive or mining waste potential to become exploitable secondary resources.

- Increasing geoscientific Knowledge & Skills for the Raw Materials in African Geological Surveys

- The course "Introduction to remote sensing" from EOEG to EGS will focus on:

  - Remote sensing sources fro mapping geology & minerals

  - Measuring ground deformations from radar data

- The 1st training will take place in Bishoftu (Ethiopia, 35 km SE from Addis Ababa) in 2017

New Geo – Community of Activity (CA)

Earth observation for Geohazards, land degradation and Environmental monitoring

- Proposed and leaded by EOEG
- To be included in GEO 2017 work programme
- Exploit current and emerging Earth Observation (EO) technologies that provide regular top- surface compositional information with a high temporal rate and high spatial resolution from: Optical, hyperspectral thermal and radar imageries
- Target: anthropogenic hazards

EUROGEOSURVEYS
European Geoscience for Society
The Geological Surveys of Europe

Muchas gracias!

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