

Hyperspectral remote sensing as a tool to map and monitor open-pit mines in Sokolov

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CGS Remote sensing unit

Established in 2005



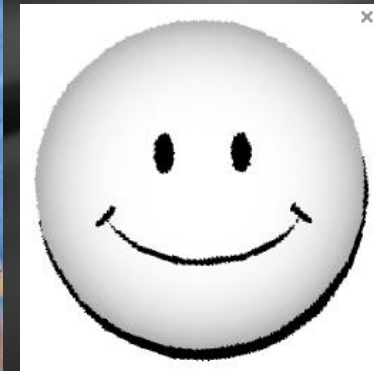
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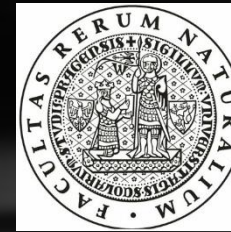


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Cooperation and partners

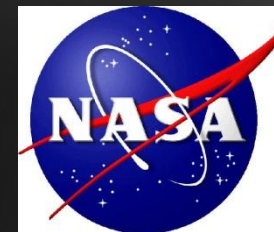
National (Czech) partners:

- [Charles University in Prague](#), Faculty of Sciences
 - Dpt. of Applied geoinformatics and cartography
 - Dpt. of Experimental plant biology
- Global change research center – [CzechGlobe](#)



International partners:

- [BRGM](#) (French geological survey)
- [DLR](#) (German Aerospace Center)
- [GSFC NASA](#) (Goddard Space flight Center, NASA)
- [TAU](#) (Tel-Aviv University)



Hypso: Hyperspectral Sokolov (2009-2012)

Primary investigator

- Veronika Kopačková, Czech Geological Survey, e-mail: veronika.kopackova@geology.cz

Co-investigators

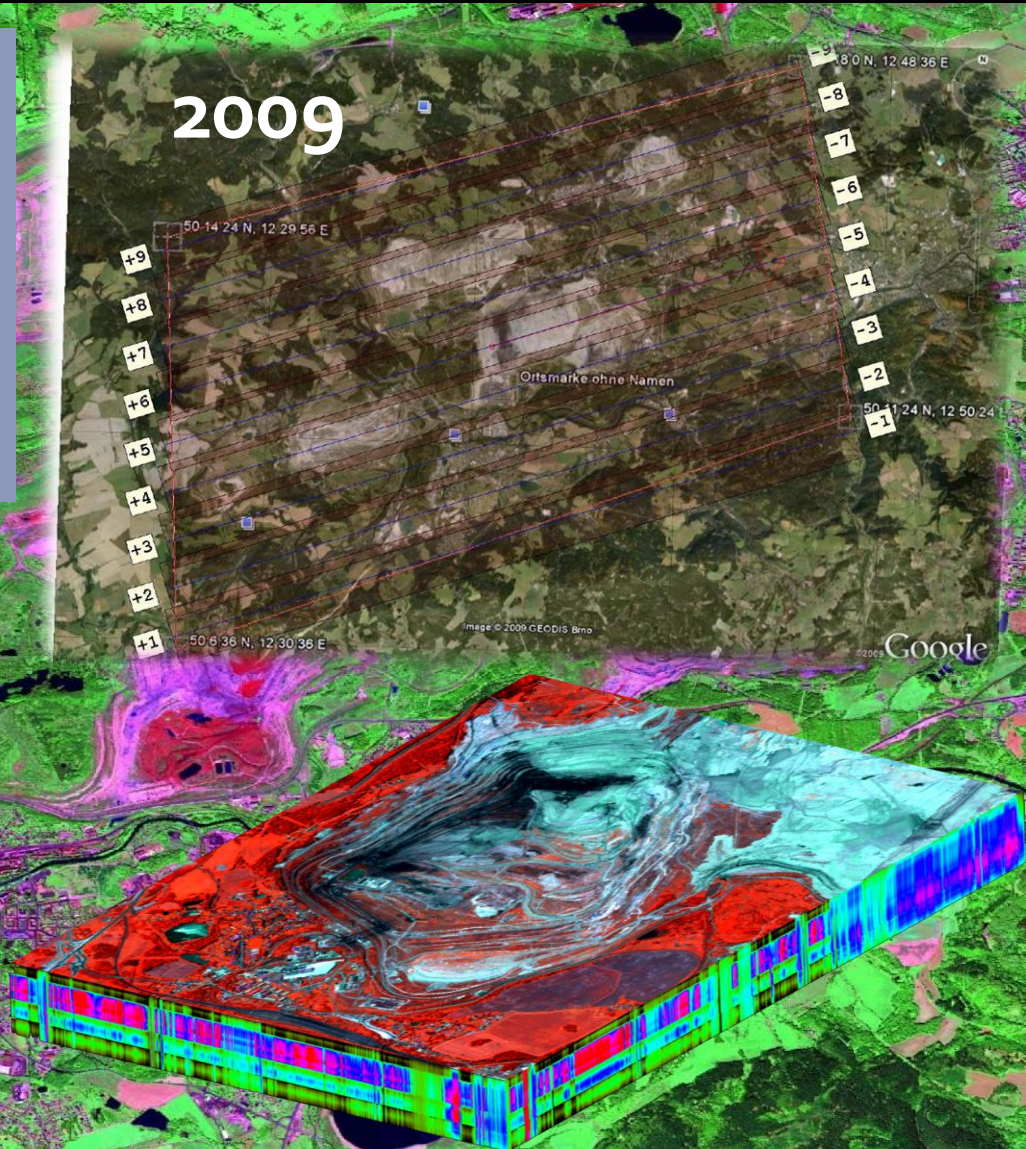
- Doc. RNDr. Jana Albrechtová, Ph.D., Department of Plant Physiology, Faculty of Science, Charles University in Prague, e-mail: albrecht@natur.cuni.cz
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Hypso: Hyperspectral Sokolov (2009-2012)

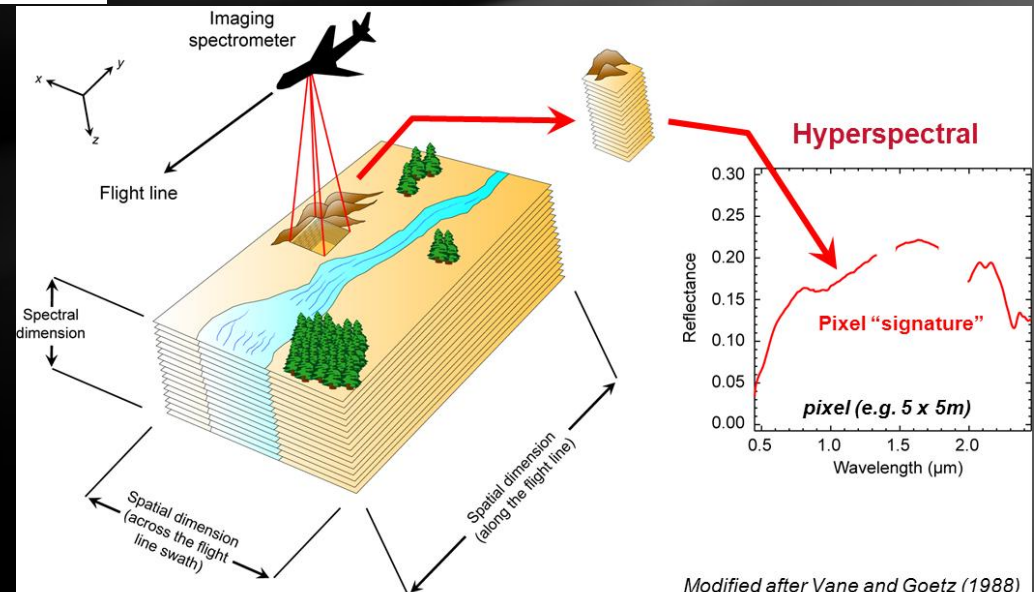
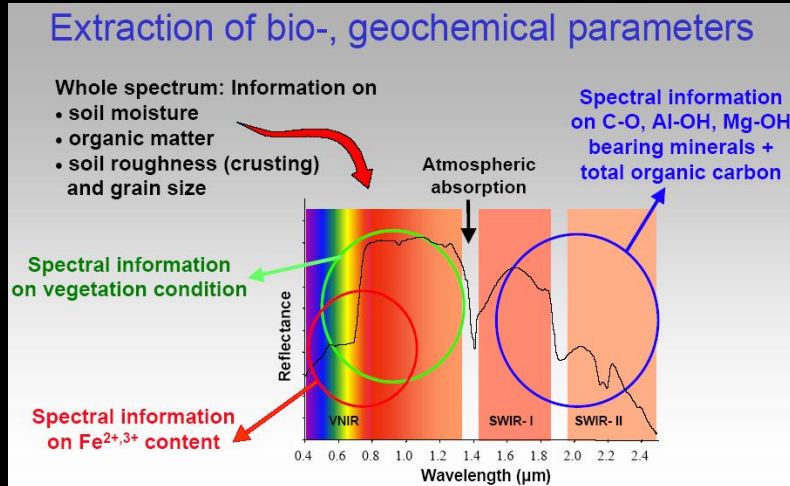
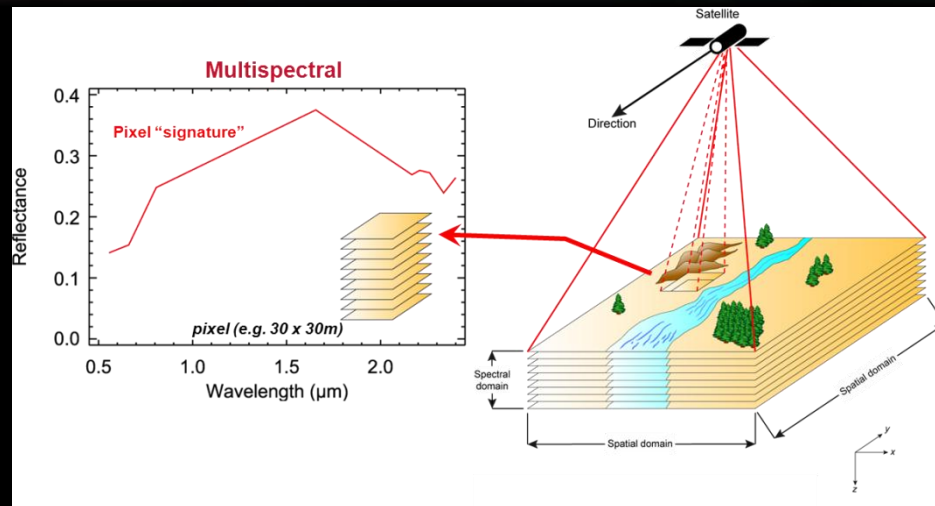
HyMap airborne hyperspectral data

- 125 bands
- 450-2500 nm
- FWHM: 15 nm
- Spatial resolution 5m/pix



Hyperspectral vs. multispectral

The acquisition of images in hundreds of registered contiguous spectral bands such that for each picture element it is possible to derive a complete reflectance/emittance spectrum (Goetz 1983)



Modified after Vane and Goetz (1988)

EO-Miners (2010-2013)

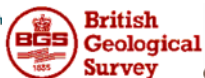


Primary Investigator:

- Stéphane Chevrel (BRGM)

Focus of the project:

- European FP7 project
- Application of Earth Observation (EO) methods for sustainable development and use of the natural and human resources
- Improvement of the interaction between mineral extractive industry and society using EO-methods and tools

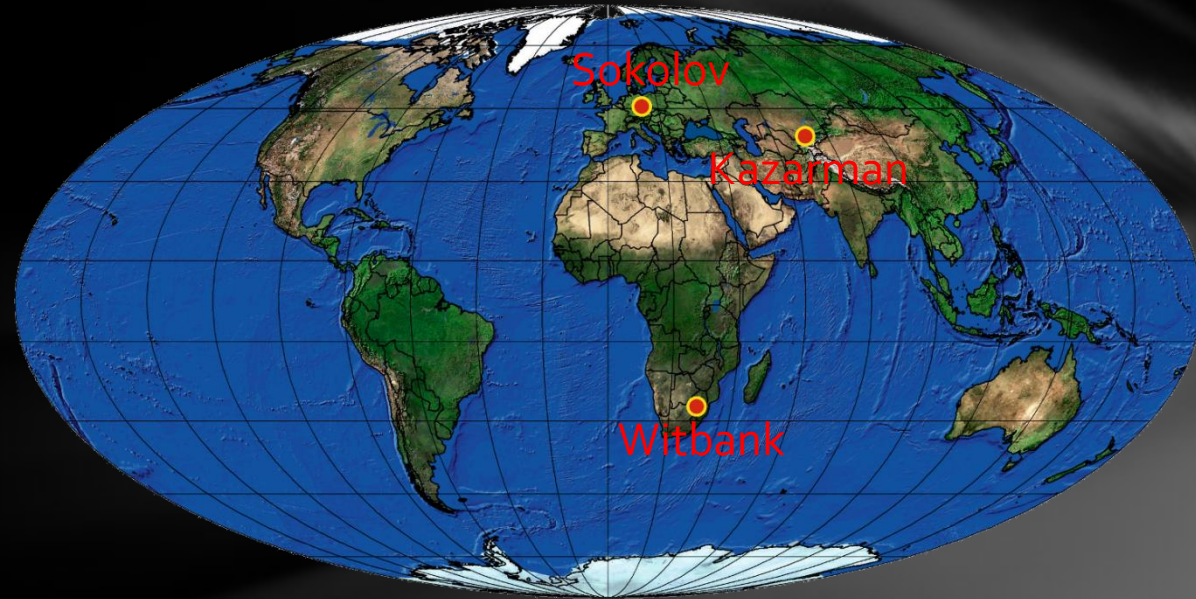


EO-Miners (2010-2013)



Test sites:

- Sokolov:
 - coal mining (Czech Republic)
- Witbank:
 - coal mining (South Africa)
- Kazarman:
 - gold mining (Kyrgyzstan)



Sokolov



Witbank



Kazarman

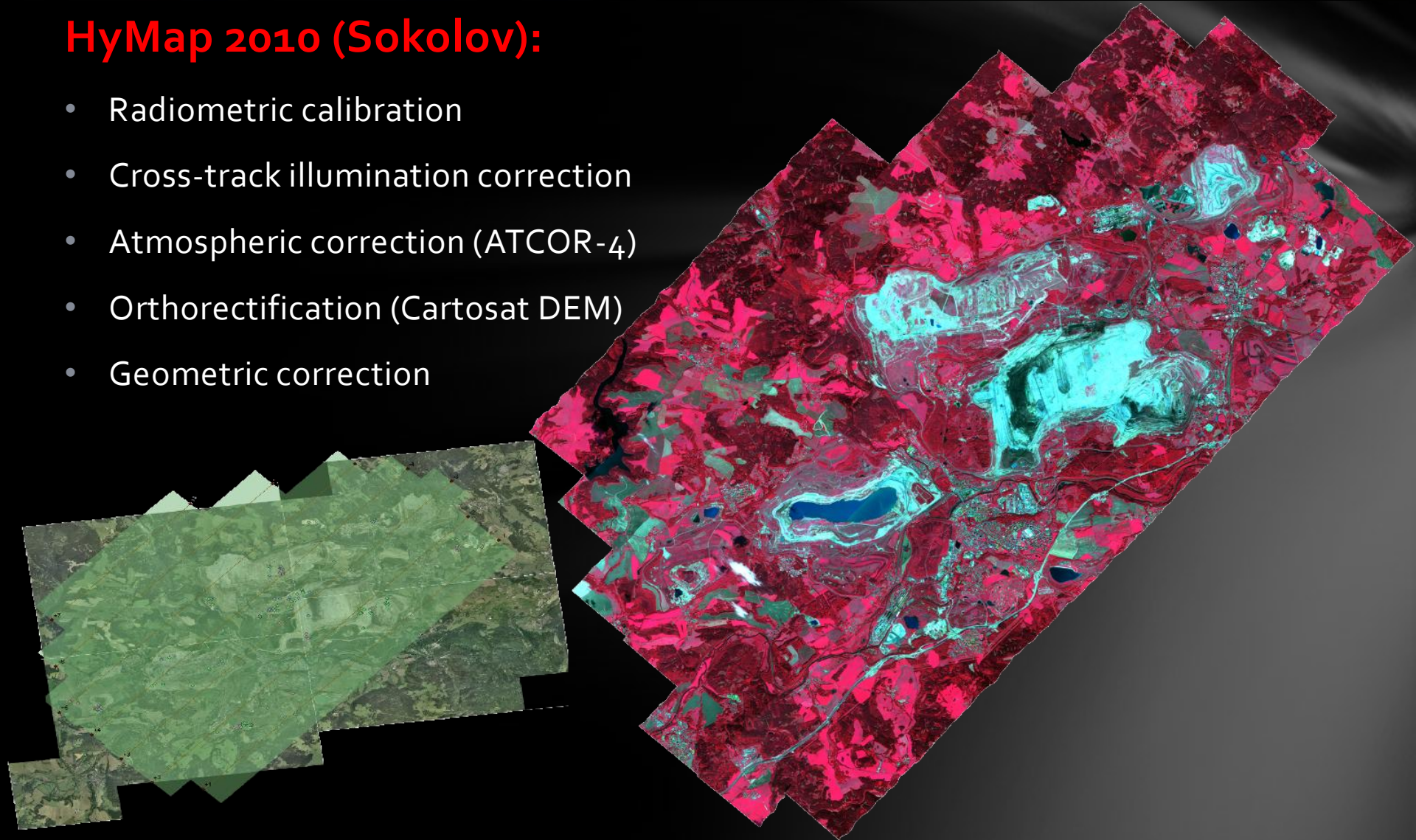


EO-Miners (2010-2013)



HyMap 2010 (Sokolov):

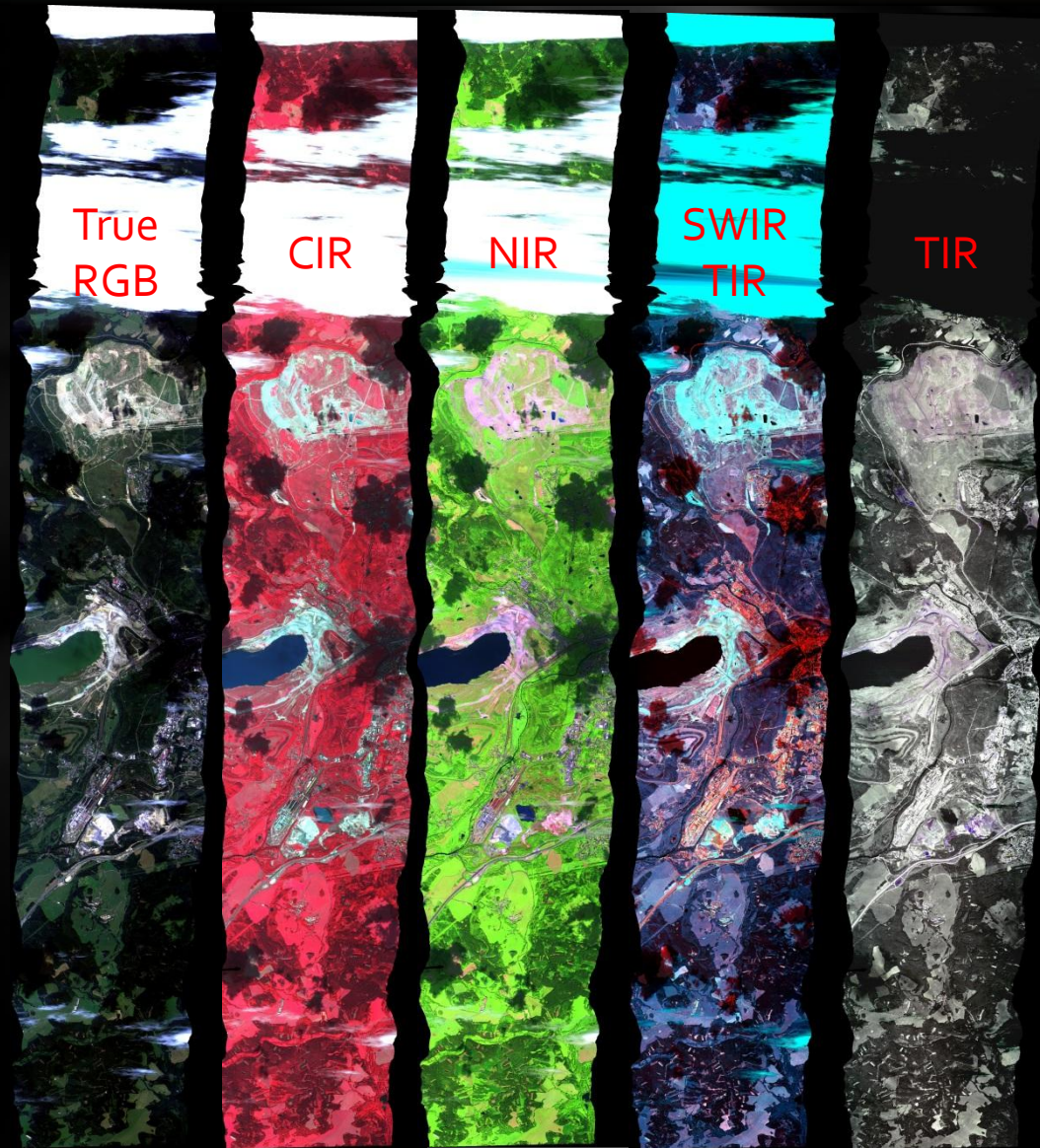
- Radiometric calibration
- Cross-track illumination correction
- Atmospheric correction (ATCOR-4)
- Orthorectification (Cartosat DEM)
- Geometric correction



De-Min-TIR (EUFAR, 2011)

Image data:

- AHS (day + night data)
 - VIS (11 bands; 0.44-0.74 μm)
 - NIR (9 bands; 0.78-1.00 μm)
 - SWIR (43 bands; 1.59-2.55 μm)
 - MIR (7 bands; 3.17-5.25 μm)
 - TIR (10 bands; 8.31-12.95 μm)
- CASI (only day data)
 - VIS+NIR (96 bands; 0.36-1.050 μm)



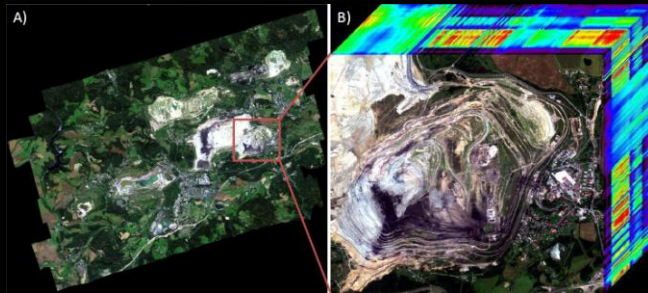
Data collecting: ground truth

Field measurements and sampling

- **ASD FieldSpec-3, μ fTIR**
 - In-situ spectrometers
- **Samples of surface material (0-1 cm depth)**
 - Dried and sieved (<2 mm)
 - Trace elements, heavy metals, XRD analysis, pH, S, total organic carbon (TOC)
- **Soil samples**
 - Heavy metals, macronutrients, TOC, S, pH,
- **Vegetation samples**
 - Leaf pigments, phenolics, water content,
 - heavy metals etc.
- **Water samples**
 - pH, dissolved organic matter, conductivity, suspension



Image Spectroscopy: products



Surface pH

Forest health

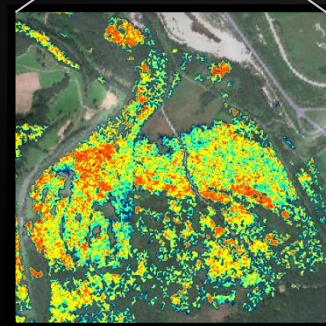
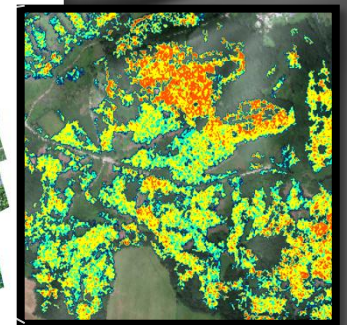
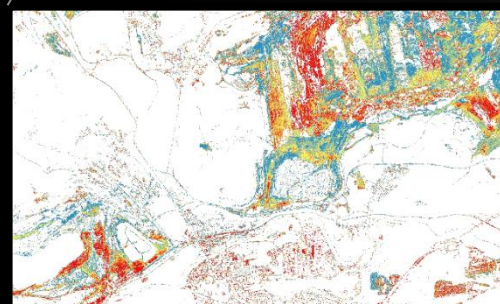
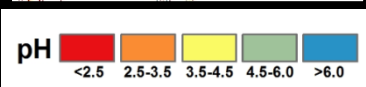
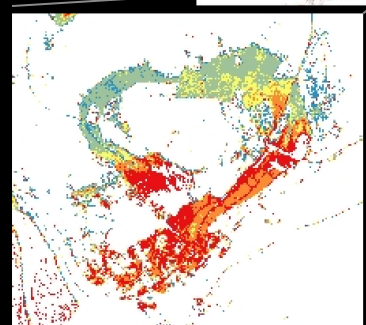
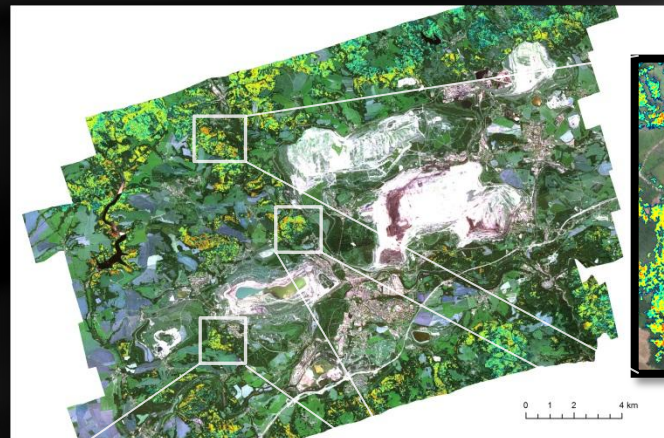
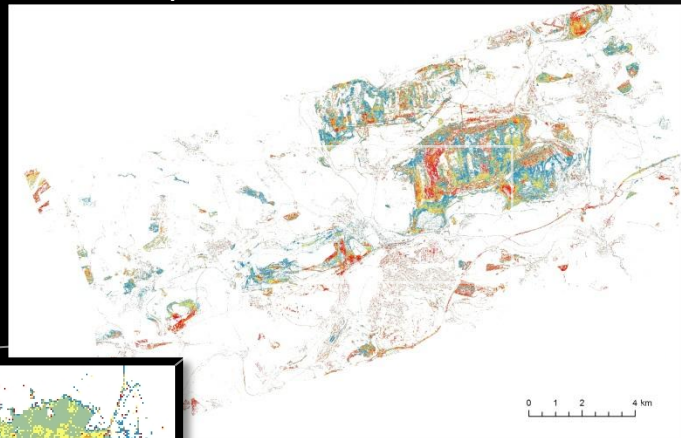
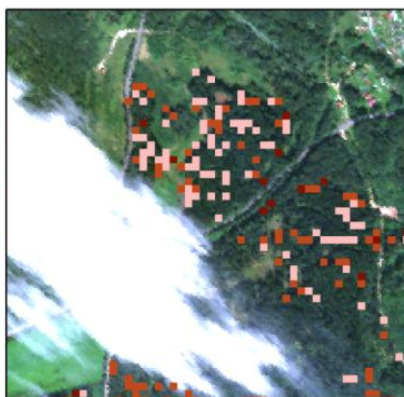


Image Spectroscopy: products



Erika



Habartov



Mezhorská



Studenec

Negative changes in health status:

- 3-class decreases and higher
- 2-class decreases
- 1-class decreases

Image Spectroscopy: products

Dissolved Fe in surface waters

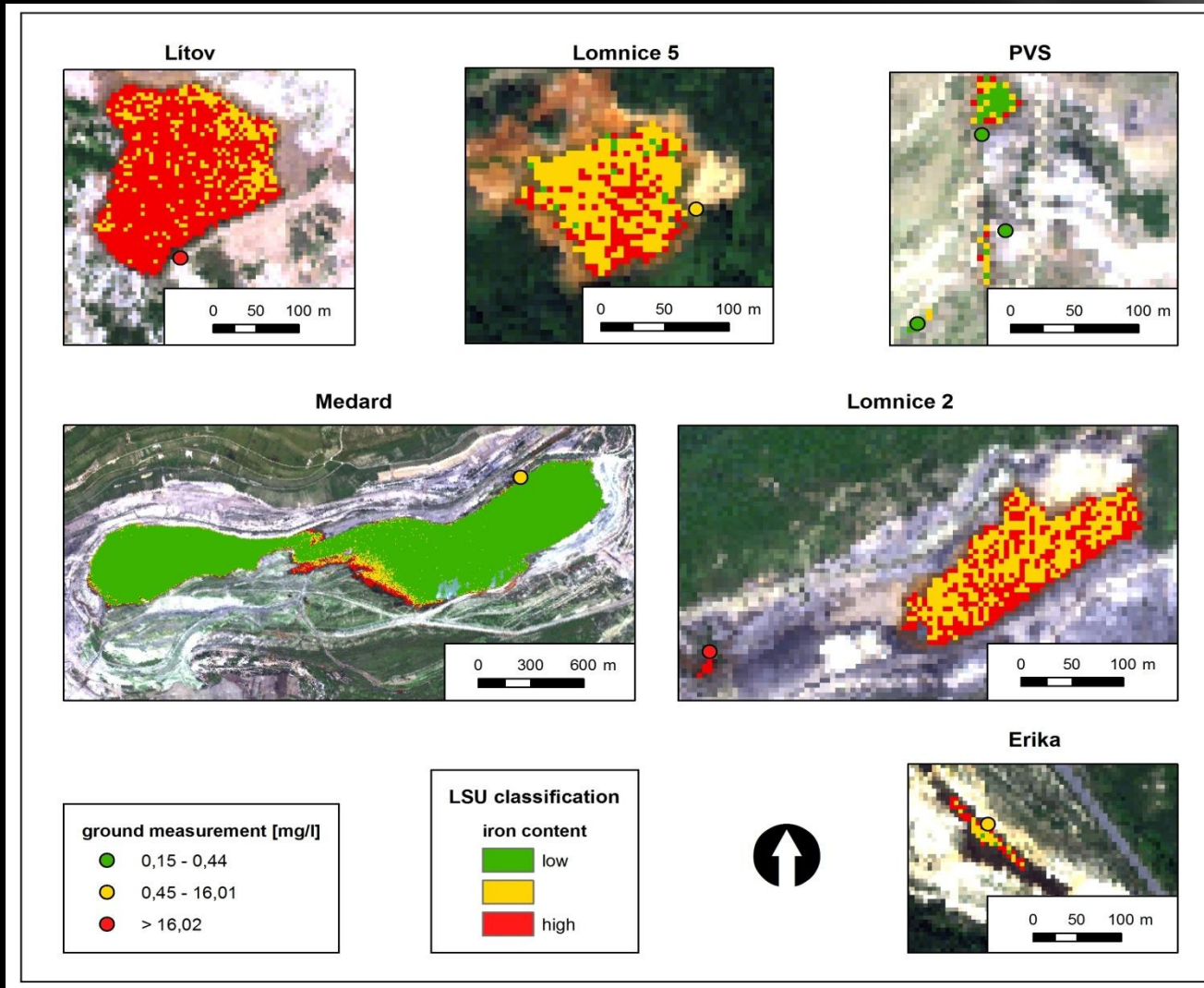
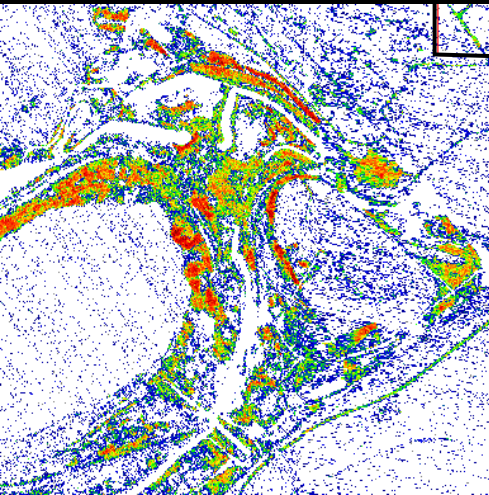
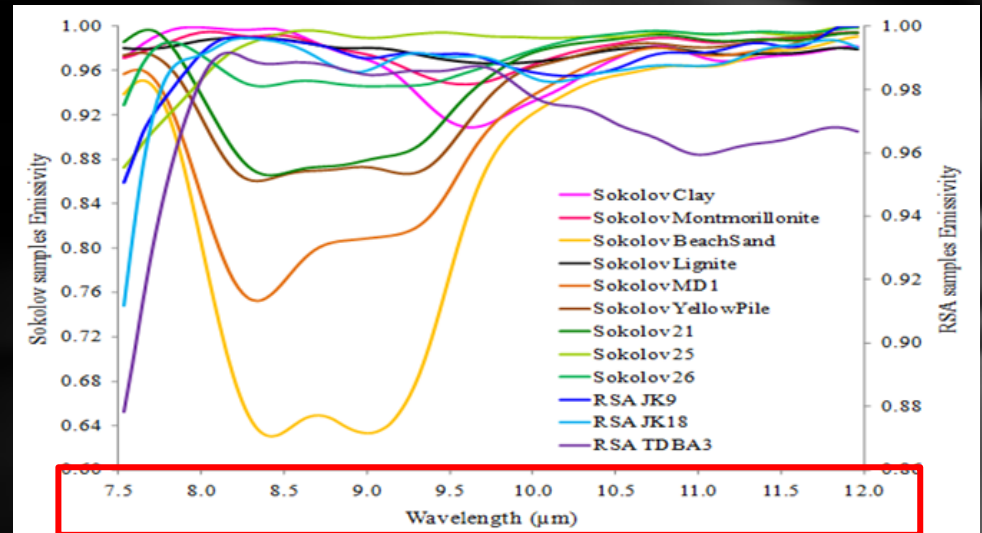
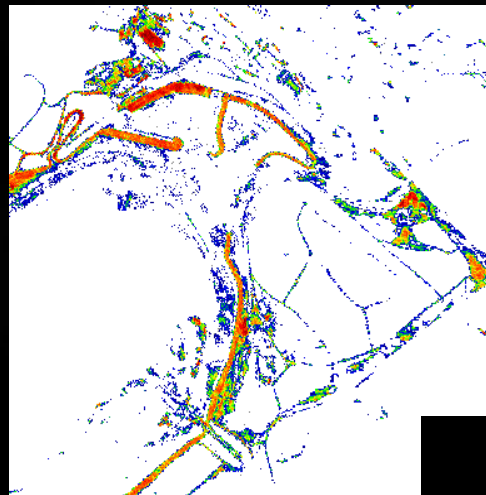


Image spectroscopy: thermal data



Clay content mapping



Sand content mapping

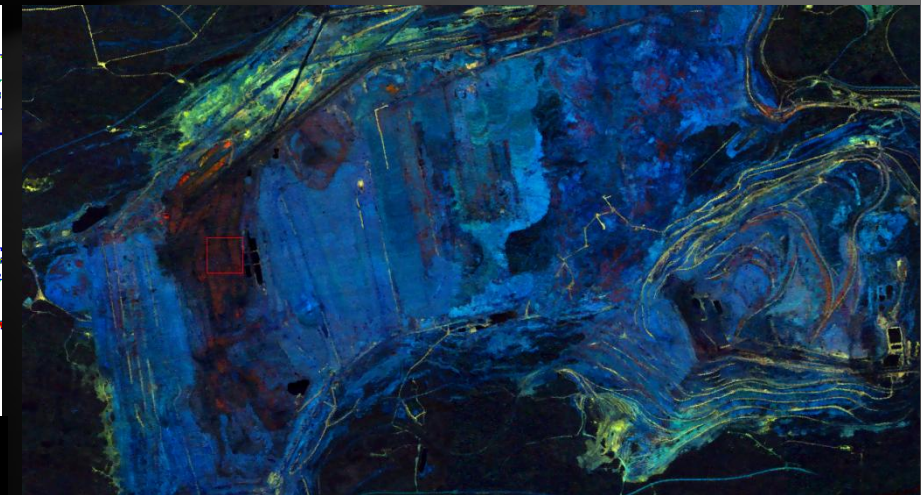
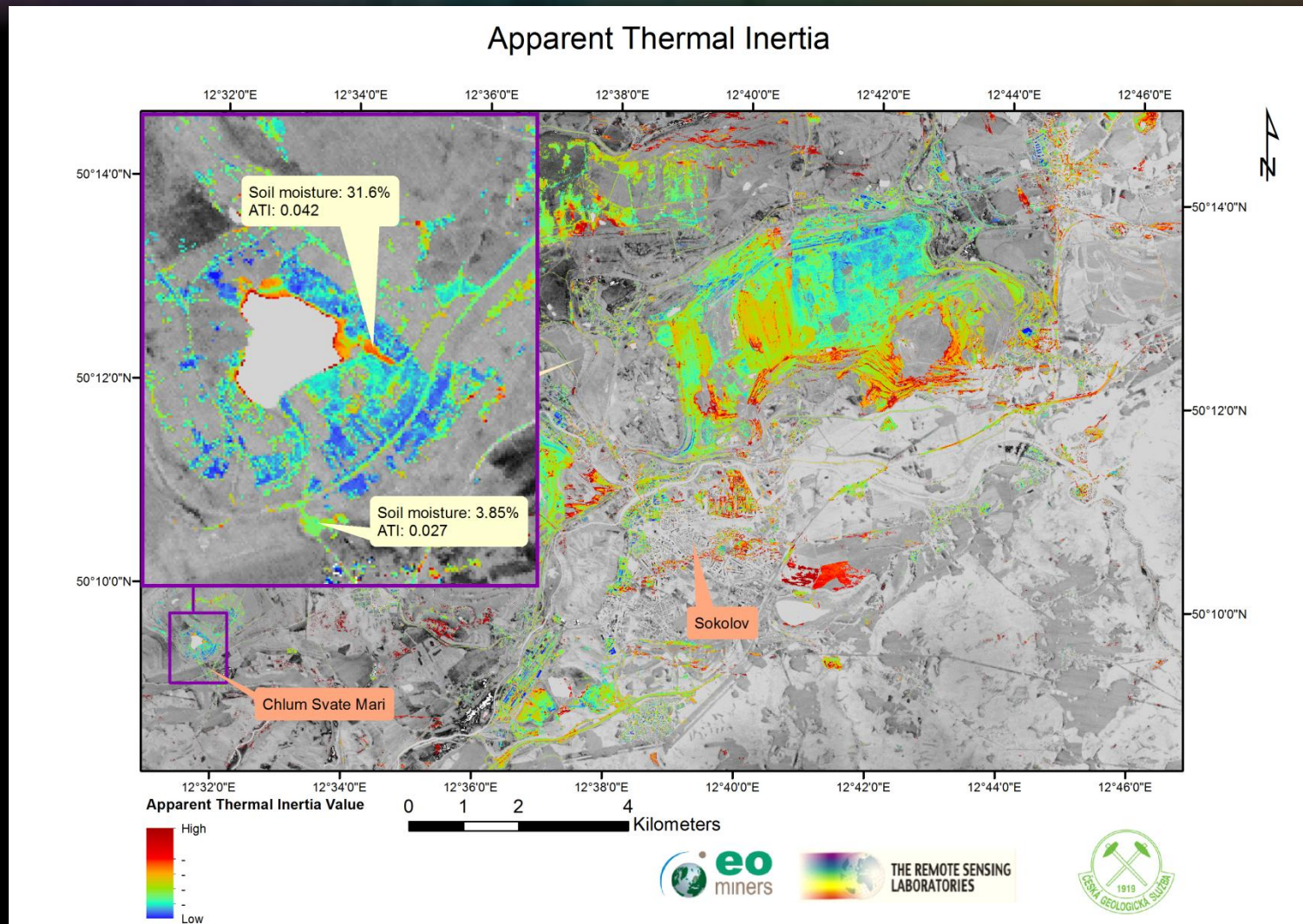
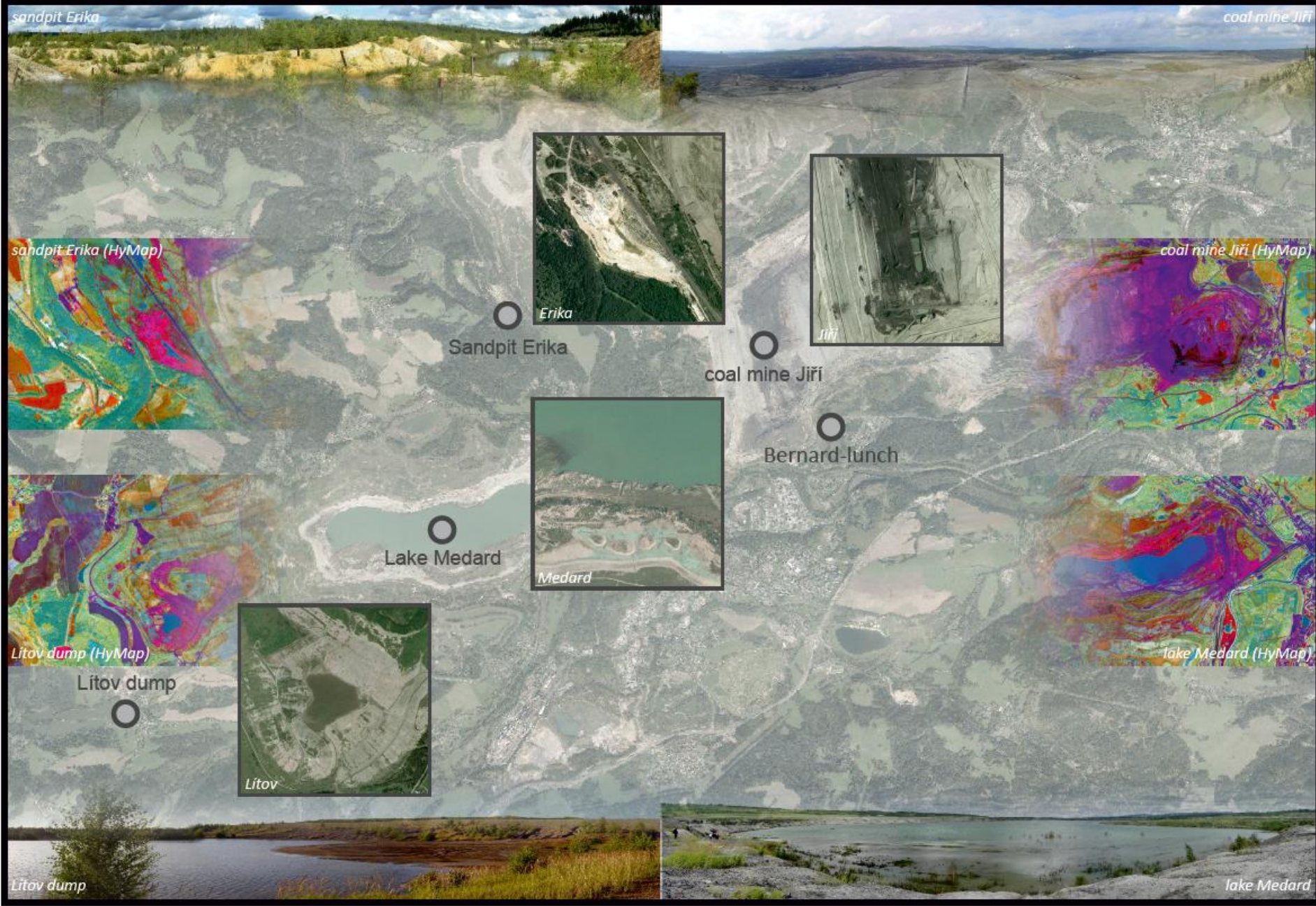


Image spectroscopy: thermal data





sandpit Erika

coal mine Jiří

sandpit Erika (HyMap)

coal mine Jiří (HyMap)



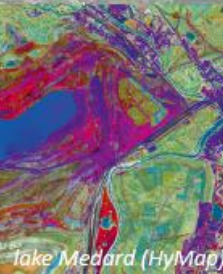
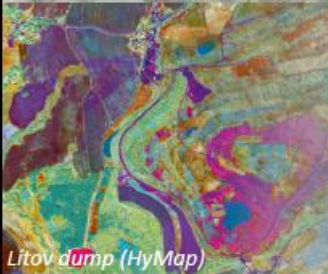
Sandpit Erika

coal mine Jiří

Bernard-lunch



Lake Medard



Litov dump



Thank you for your attention



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