

# Využití leteckých a družicových dat pro geologické aplikace

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# Pracoviště dálkového průzkumu Země

- Založeno v r. 2005



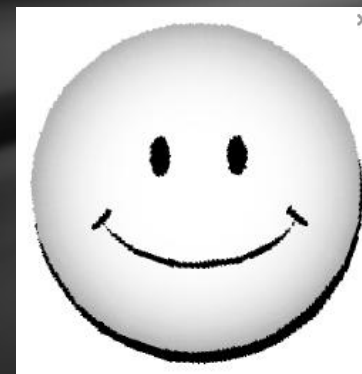
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Lucie Koucká B.Sc.  
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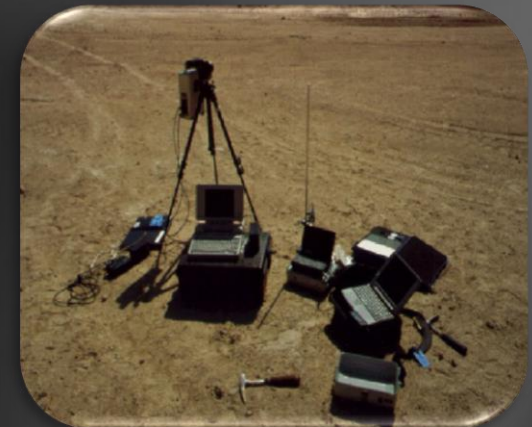
# Druhy dat - metody pozorování Země (Dálkový průzkum Země)

Satelitní data

Letecká data

In situ data

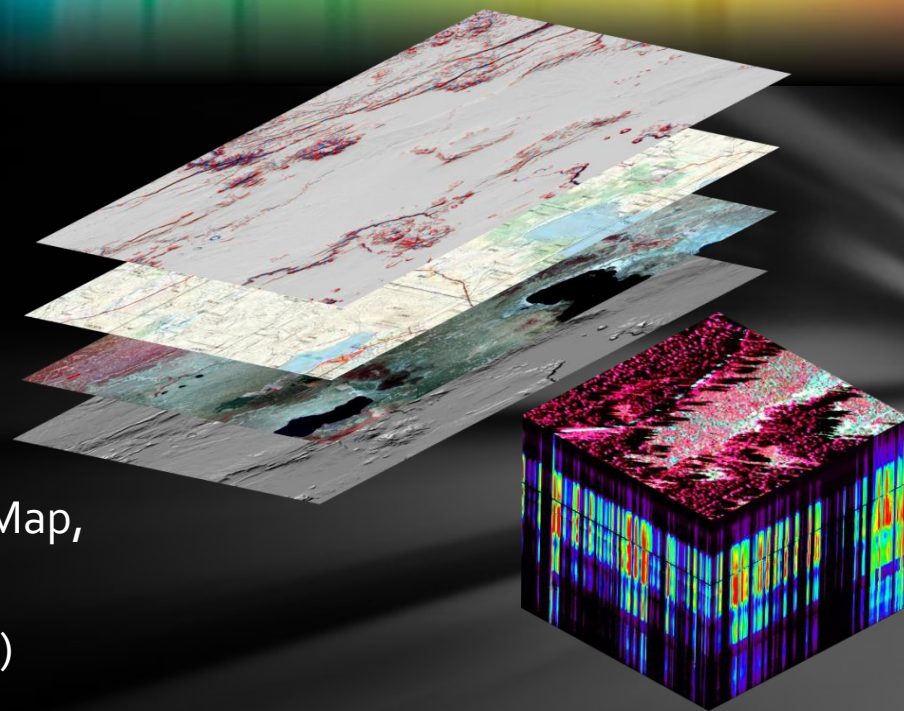
*Každý typ dat má své výhody a limity, nejlepších výsledků lze dosáhnout jejich integrací...*



# Jaká obrazová data DPZ používáme

- **Multispektrální data**
  - ASTER, LANDSAT,
- **Radarová data**  
(SAR, ALOS PALSAR)
- **Hyperspektrální data**
  - Hyperspectral airborne data (HyMap, CASI)
  - Thermal multispectral data (AHS)
- **Geo-informatické produkty** relevantní pro geologické a geomorfologické

↑  
Multitemporální  
↓

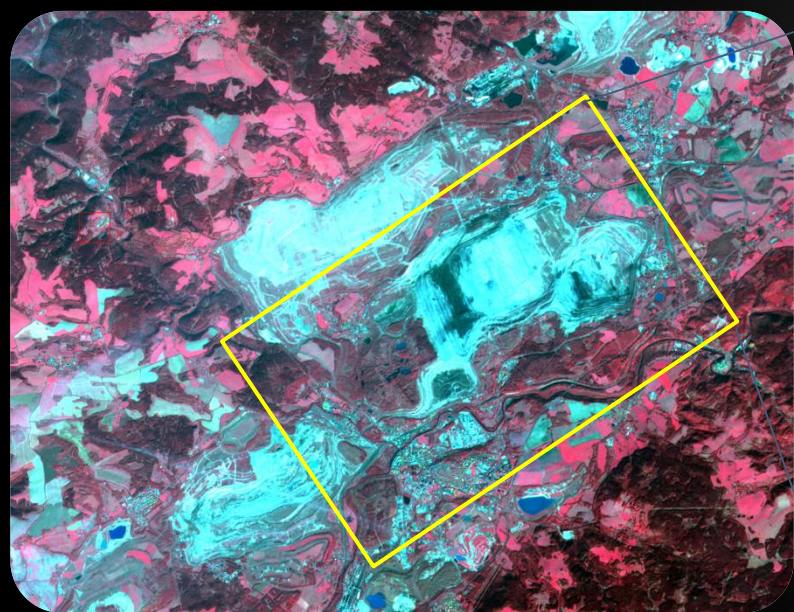


- **Prostorová analýza**
- **Změny v čase**

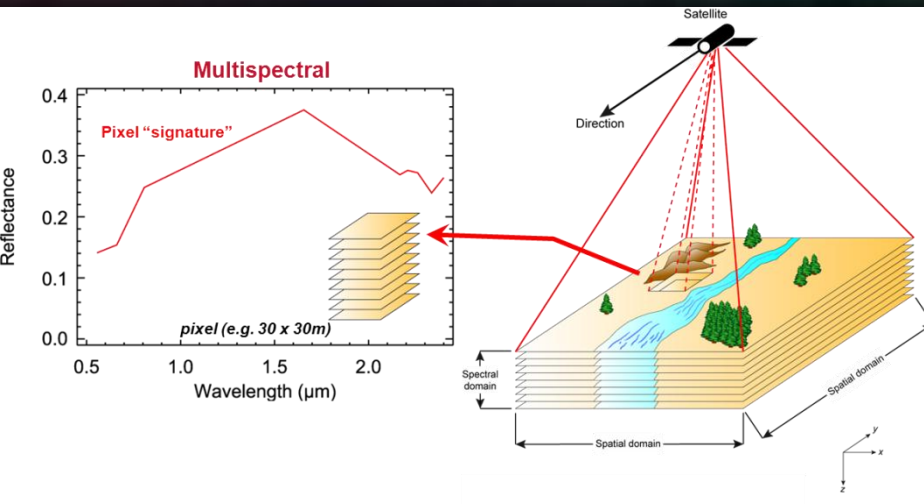


# Parametry obrazových dat DPZ

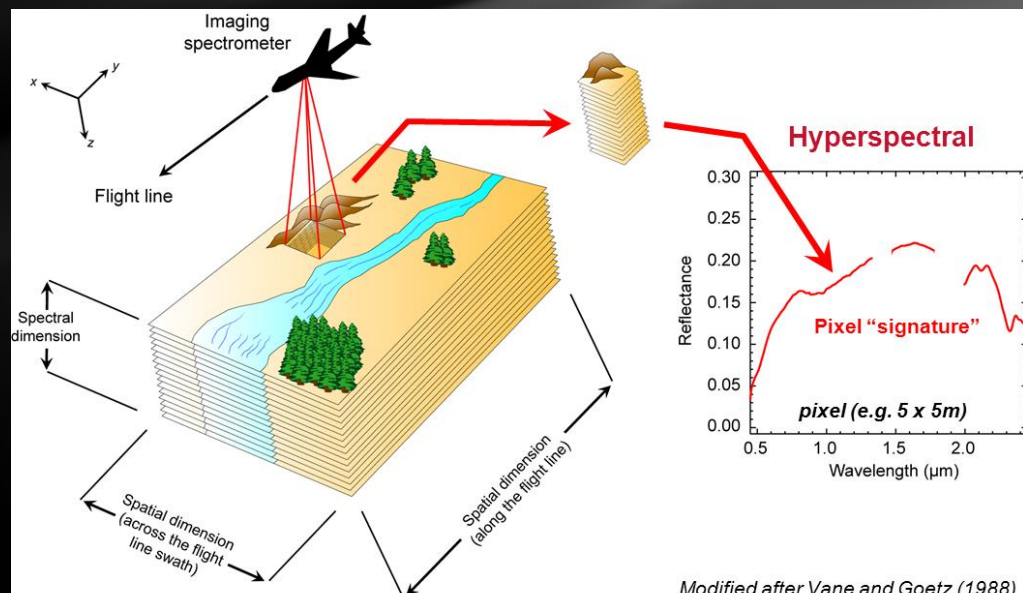
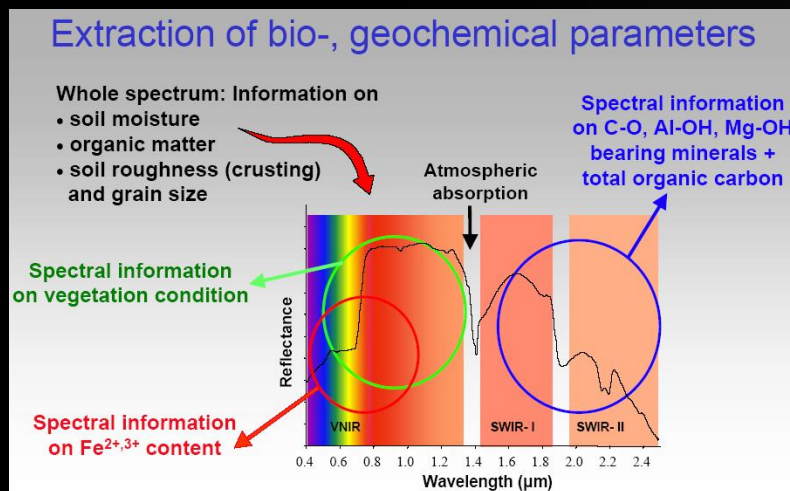
*Prostorové vs. spektrální rozlišení*



# Parametry obrazových dat DPZ

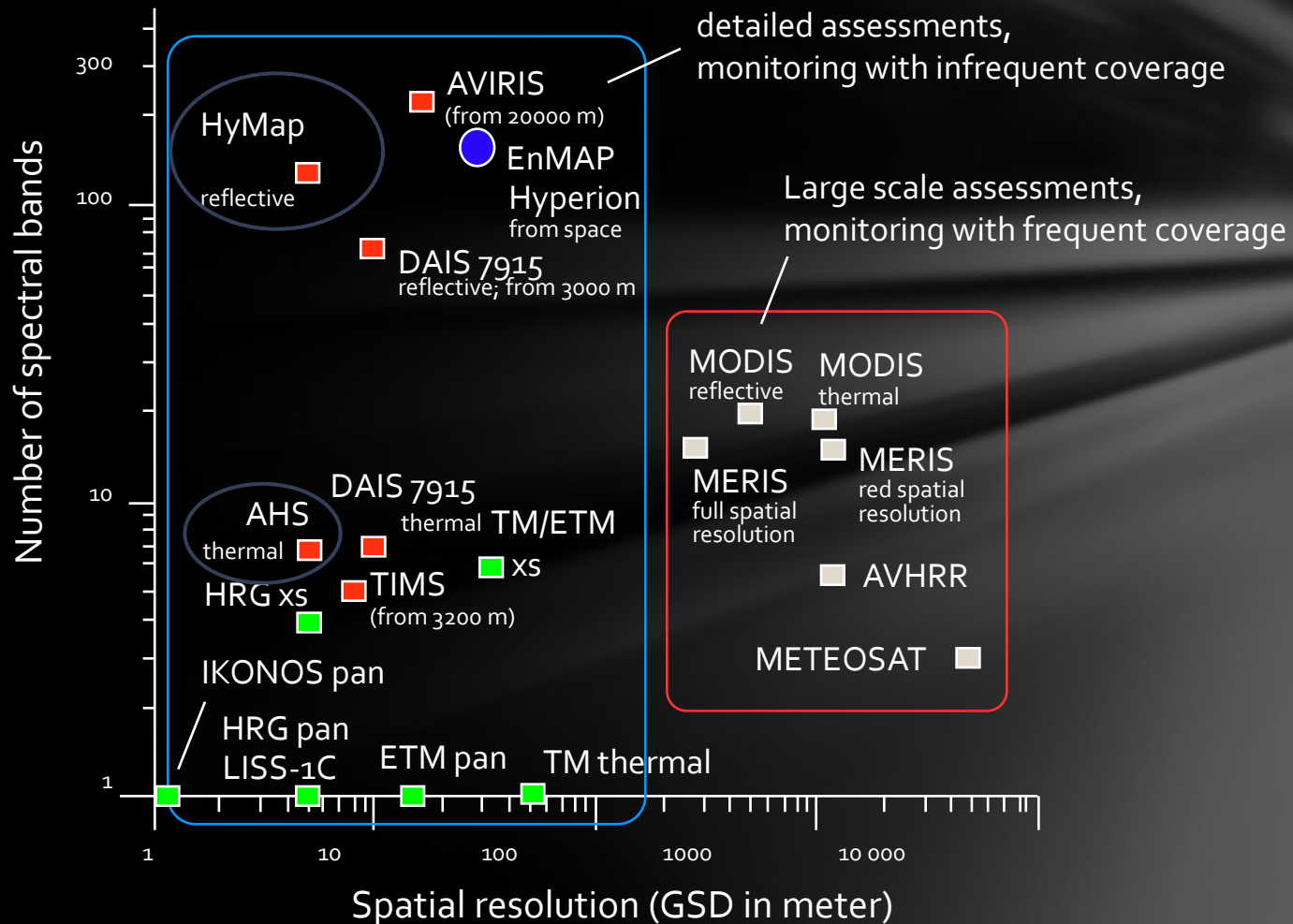


The acquisition of images in hundreds of registered continuous spectral bands such that for each picture element it is possible to derive a complete reflectance spectrum (Goetz 1983).



Modified after Vane and Goetz (1988)

# Prostorové vs. spektrální rozlišení



**Spektrální rozsah: VNIR/SWIR**

# Financování, podpora

**MŽP, TAČR, FP7, GAČR, MŠMT, SÚRAO**

El Salvador, Peru, Etiopie, Mongolsko

Sokolovsko, Krušné hory

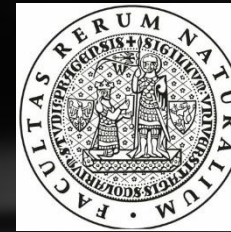
Boletice, Rožínka



# Spolupráce

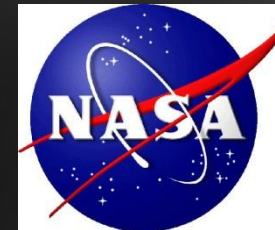
## Spolupráce v rámci ČR:

- [Karlova univerzita v Praze](#), Přírodovědecká fakulta
  - Dpt. of Applied geoinformatics and cartography
  - Dpt. of Experimental plant biology
- Global change research center – [CzechGlobe \(AV ČR\)](#)



## Mezinárodní spolupráce:

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



# PanGeo (2011-2013)

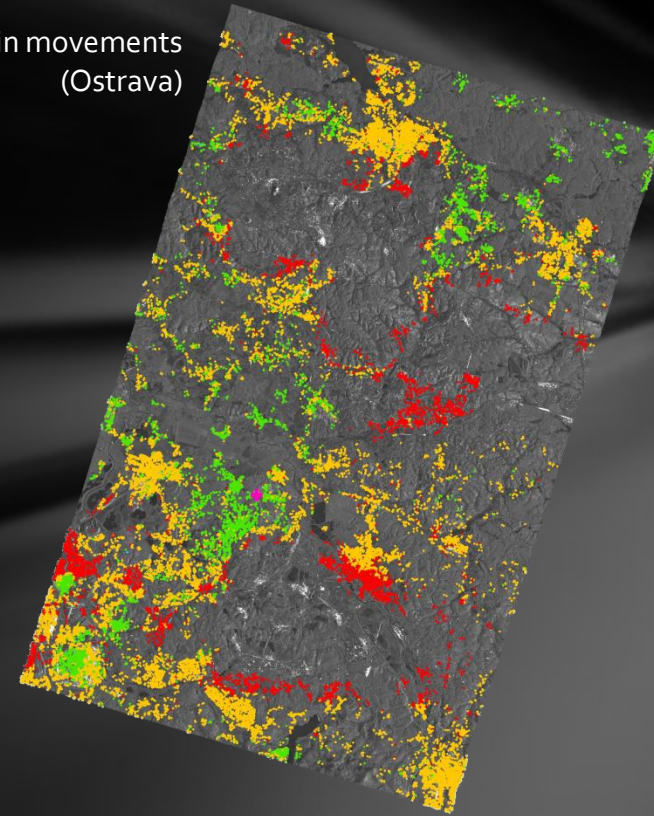
## Primary investigator:

- Ren Capes (FNPA)

## Focus of the project:

- European FP7 project, GMES
- Monitoring of vertical terrain movements (uplifting X subsidence) in large urban areas
- 52 cities of EU27 (2 from each member state except of Cyprus and Luxembourg)
- Geohazard information to the Urban Atlas

Vertical terrain movements  
(Ostrava)



# PanGeo (2011-2013)

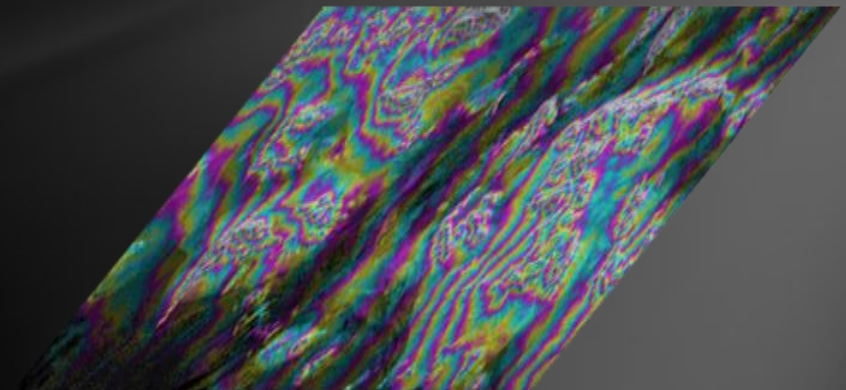
## Test sites (Czech republic):

- Prague (infrastructure building)
- Ostrava (long term coal mining)

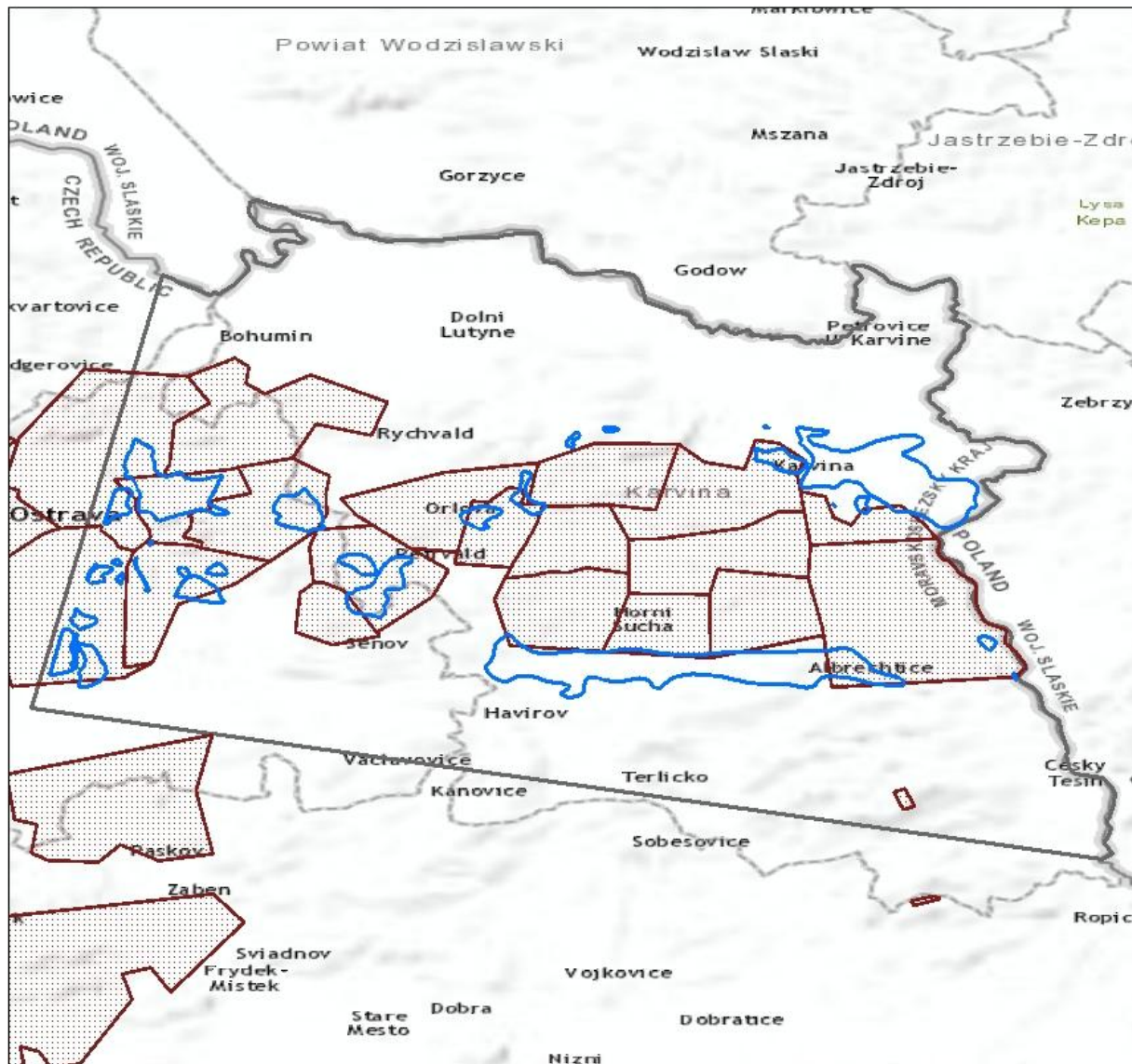


## Data and methods:




- Persistent Scatter Radar Interferometry (PSI)
- ERS<sub>1</sub>/ERS<sub>2</sub> interferometric data
- Interpretation of the point terrain vertical movements datasets → reasons and consequences
- Linking with other local datasets

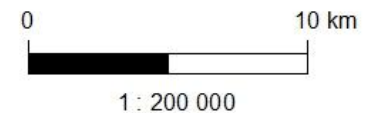


# PanGeo (2011-2013)



## Legend

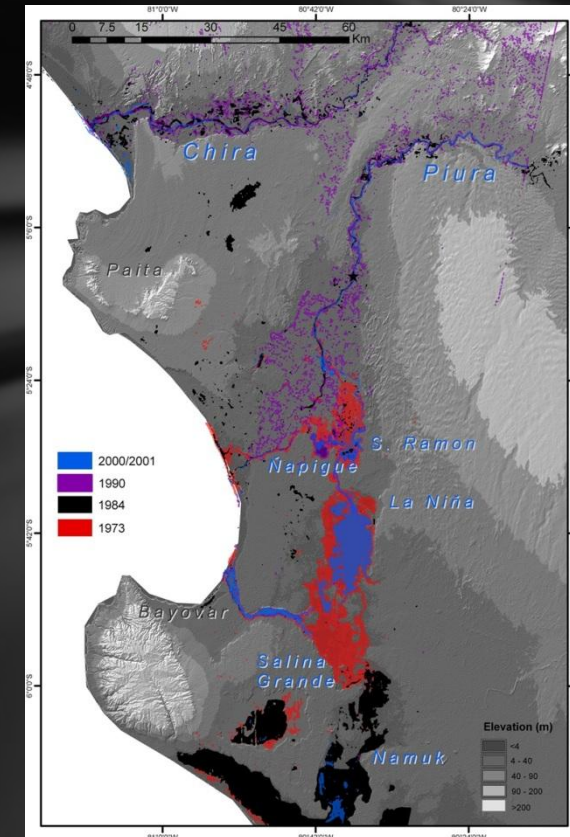
-  Ostrava area of interpretation
-  Ostrava GSL selection: observed PSI points
-  Abandoned mine lands



# Ukončené projekty: Peru

## Detection of El-Niño induced changes based on analysis of multitemporal EO data

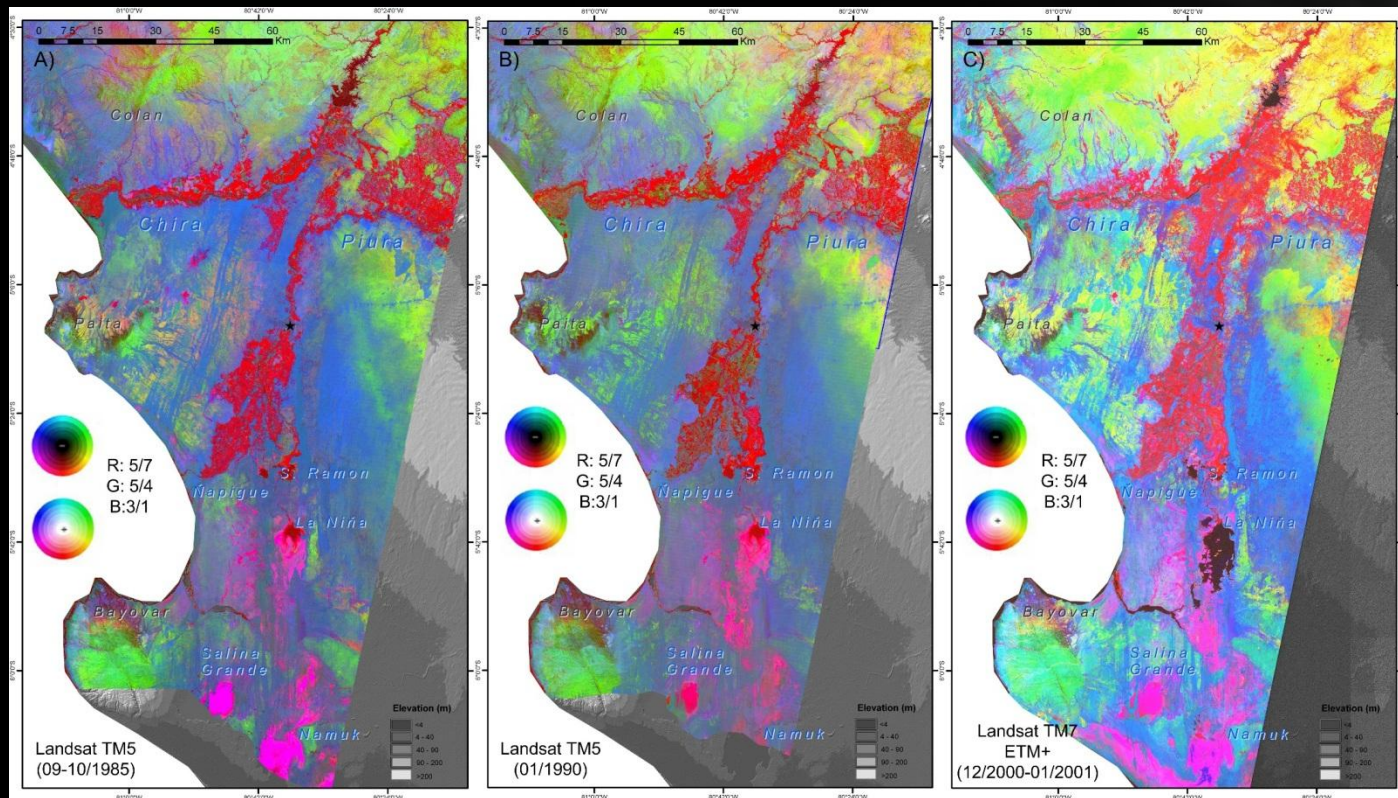
- NW Peru
- Sechura desert
- Landsat MSS and TM
  - 1973, 1984 (MSS)
  - 1985, 1990 (TM)
  - 2000, 2001 (ETM+)
- ASTER
  - 2006, 2007



Changes in geometry/position of the river channels and extend of the lakes 1973-2000/2001

# Ukončené projekty: Peru

## Detection of El-Niño induced changes based on analysis of multitemporal EO data

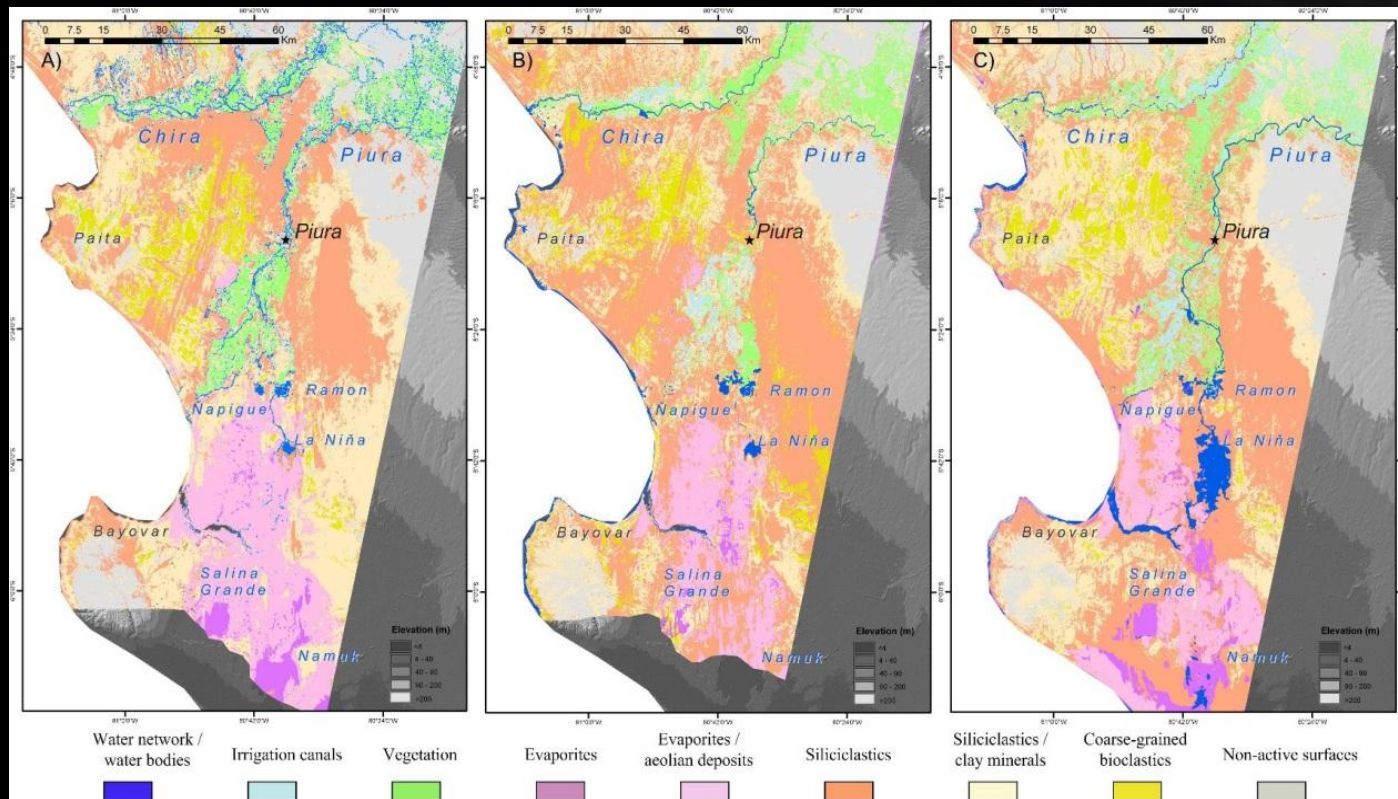


Mineral composition color scheme of Landsat TM data

A) 1985 B) 1990 C) 2000/2001

# Ukončené projekty: Peru

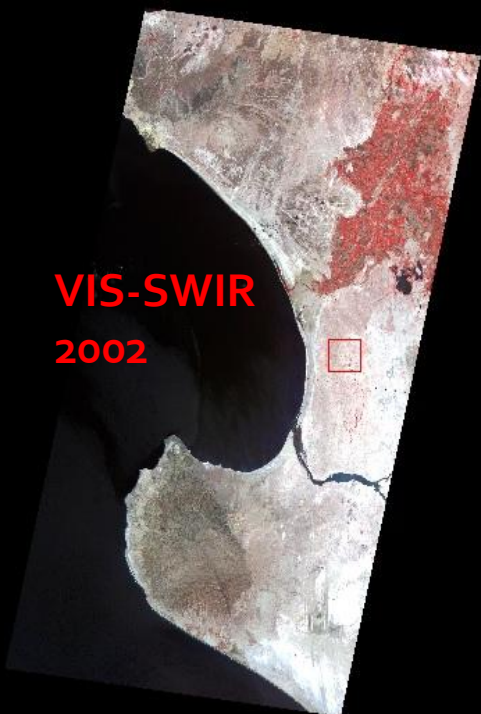
## Detection of El-Niño induced changes based on analysis of multitemporal EO data



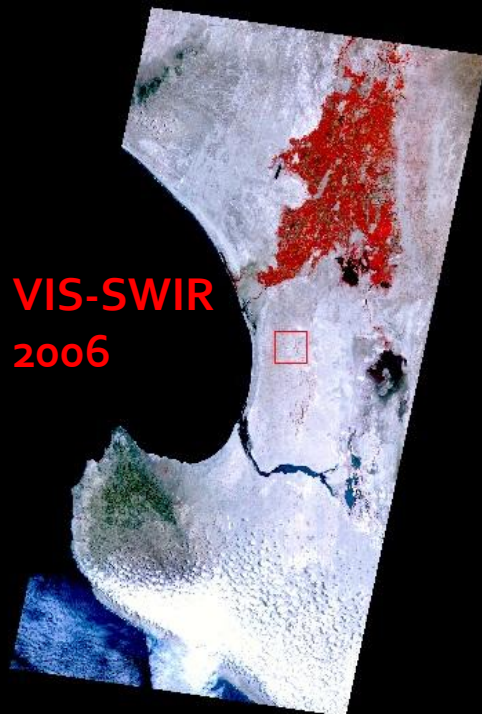
Land cover classification of Landsat TM data

A) 1985 B) 1990 C) 2000/2001

**VIS-SWIR**  
2002



**VIS-SWIR**  
2006



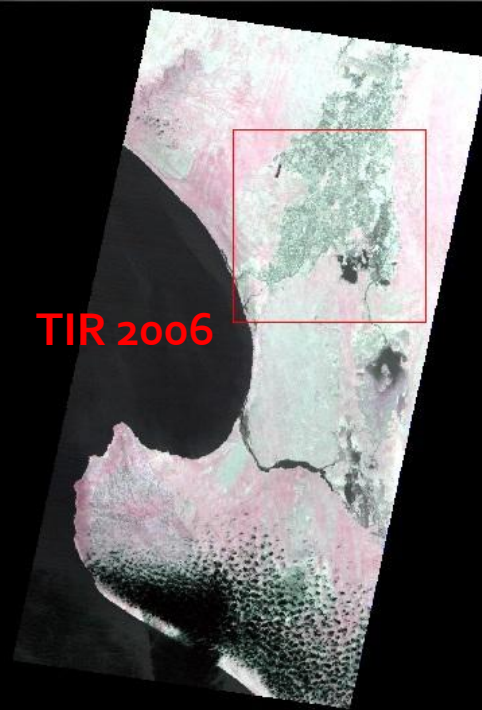
**VIS-SWIR**  
2007



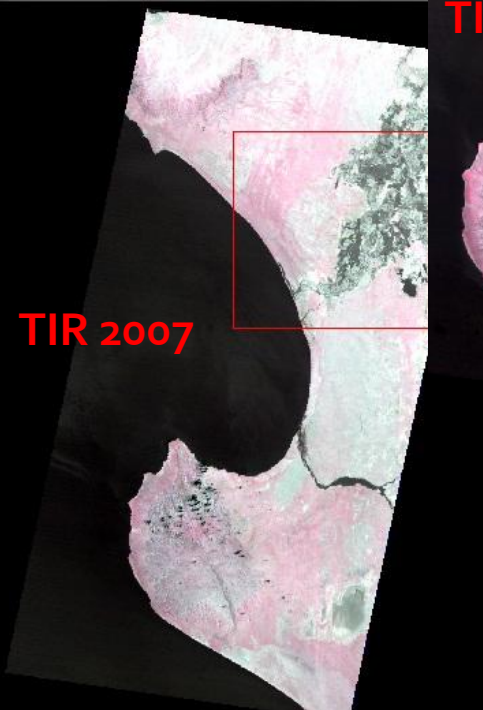
**TIR** 2002



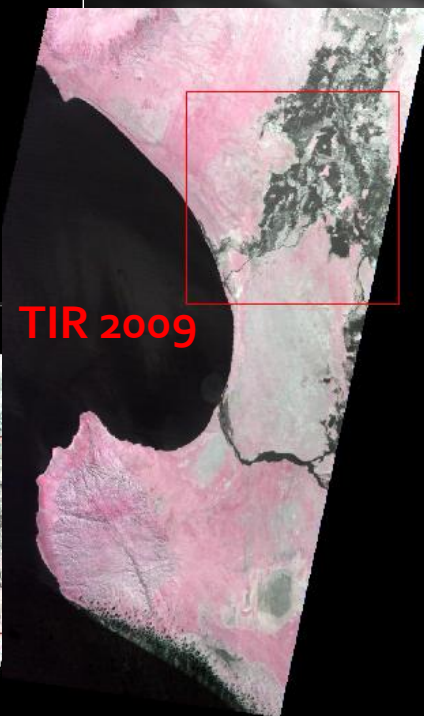
**TIR** 2006



**TIR** 2007



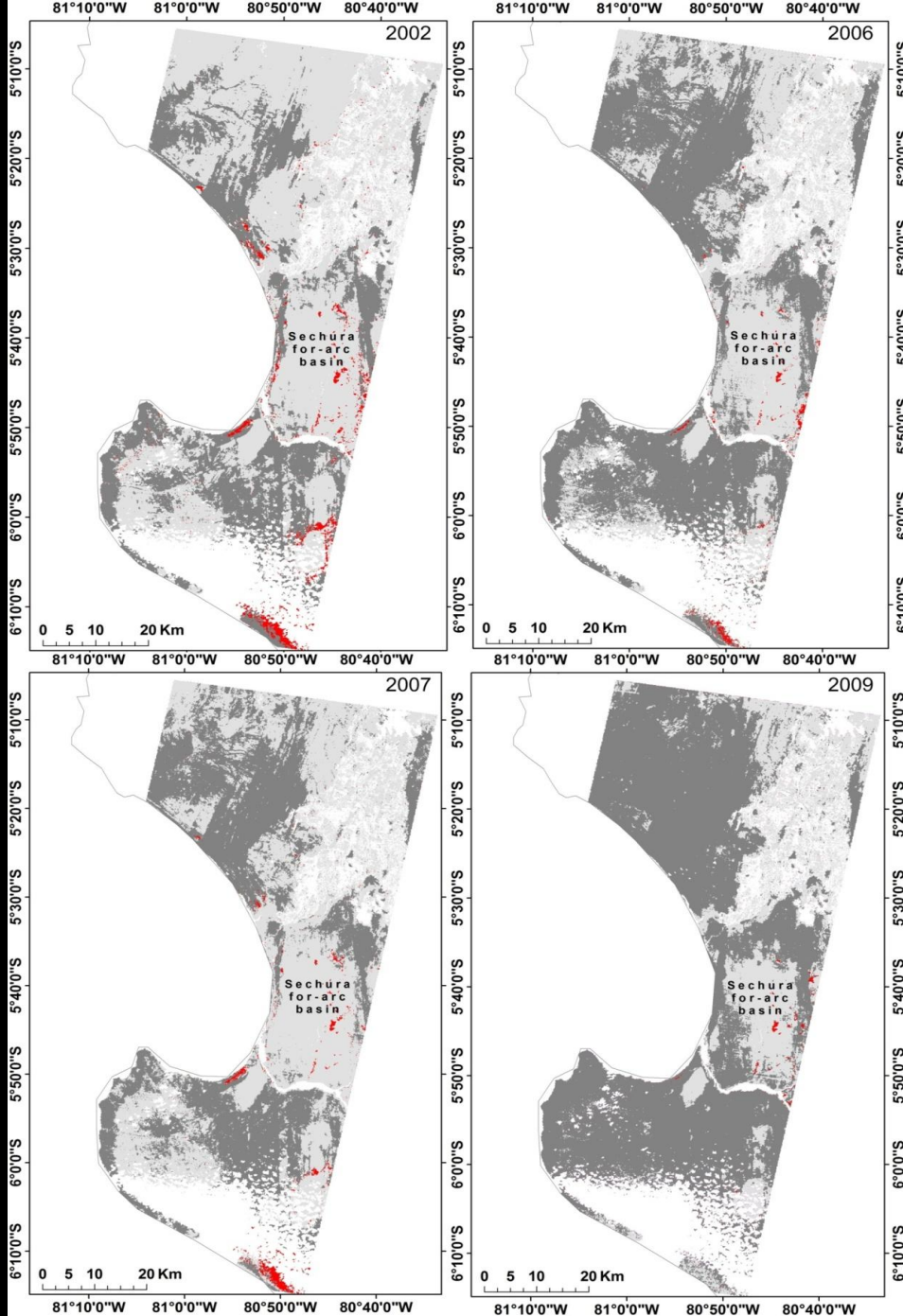
**TIR** 2009



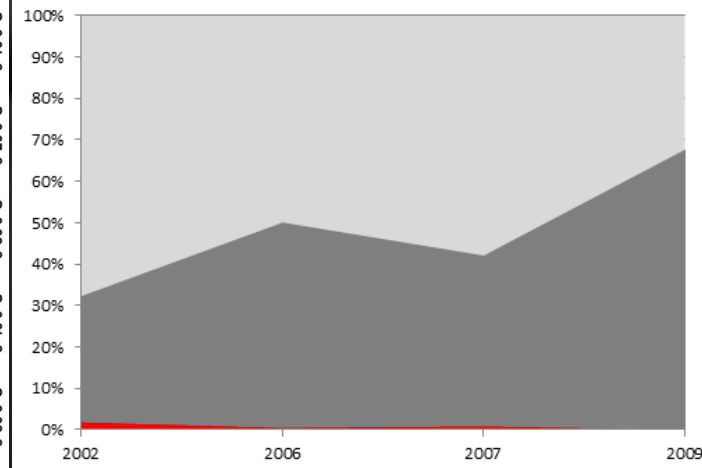
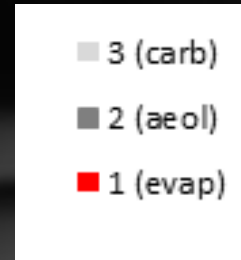
**ASTER/  
TERRA**



# Results: Spatio-temporal changes (2002-2009) in sedimentary surfaces

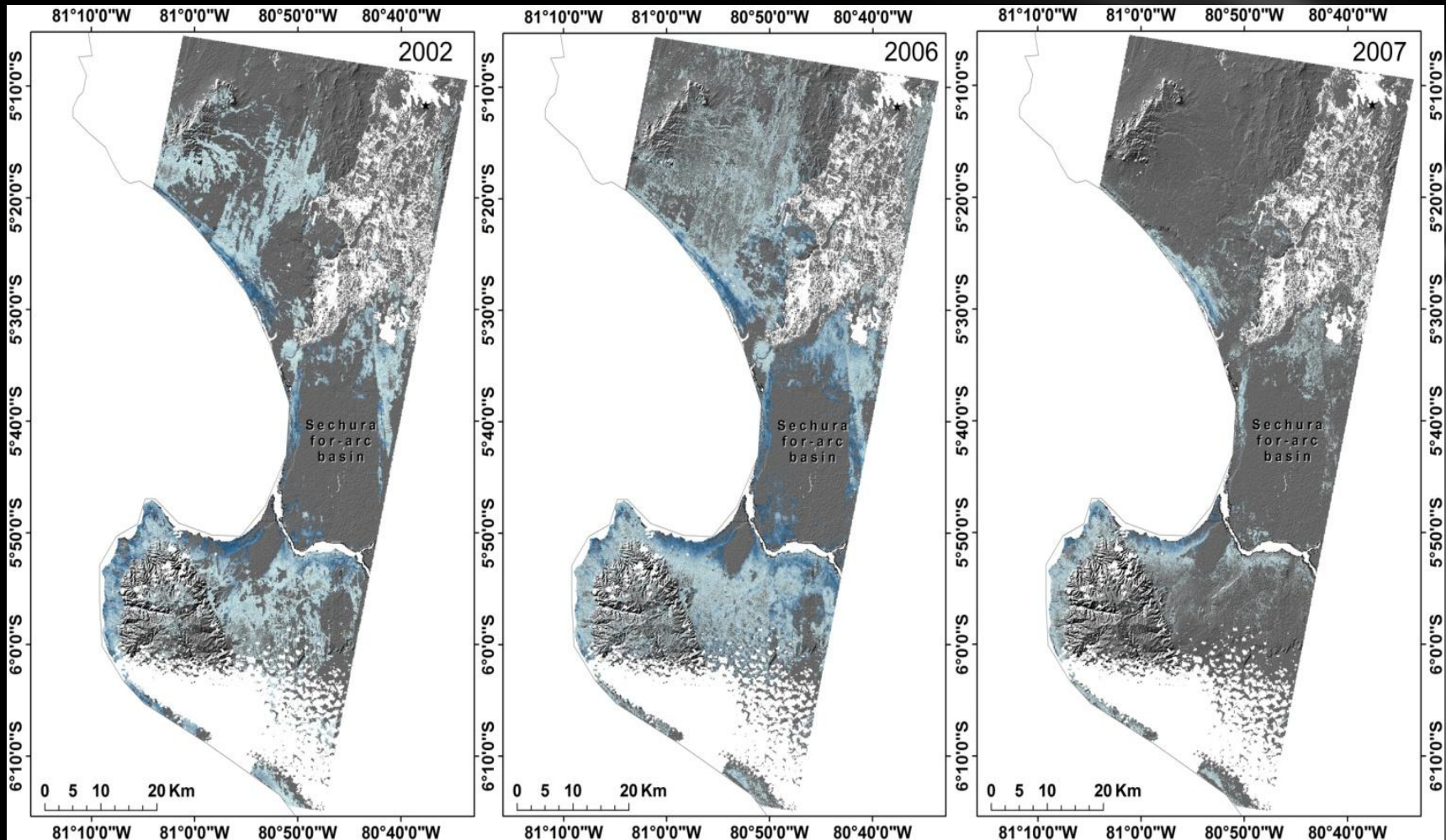


Extent of the sedimentary surfaces (carbonates, aeolian sediments, evaporates) and its dynamics between 2002-2009



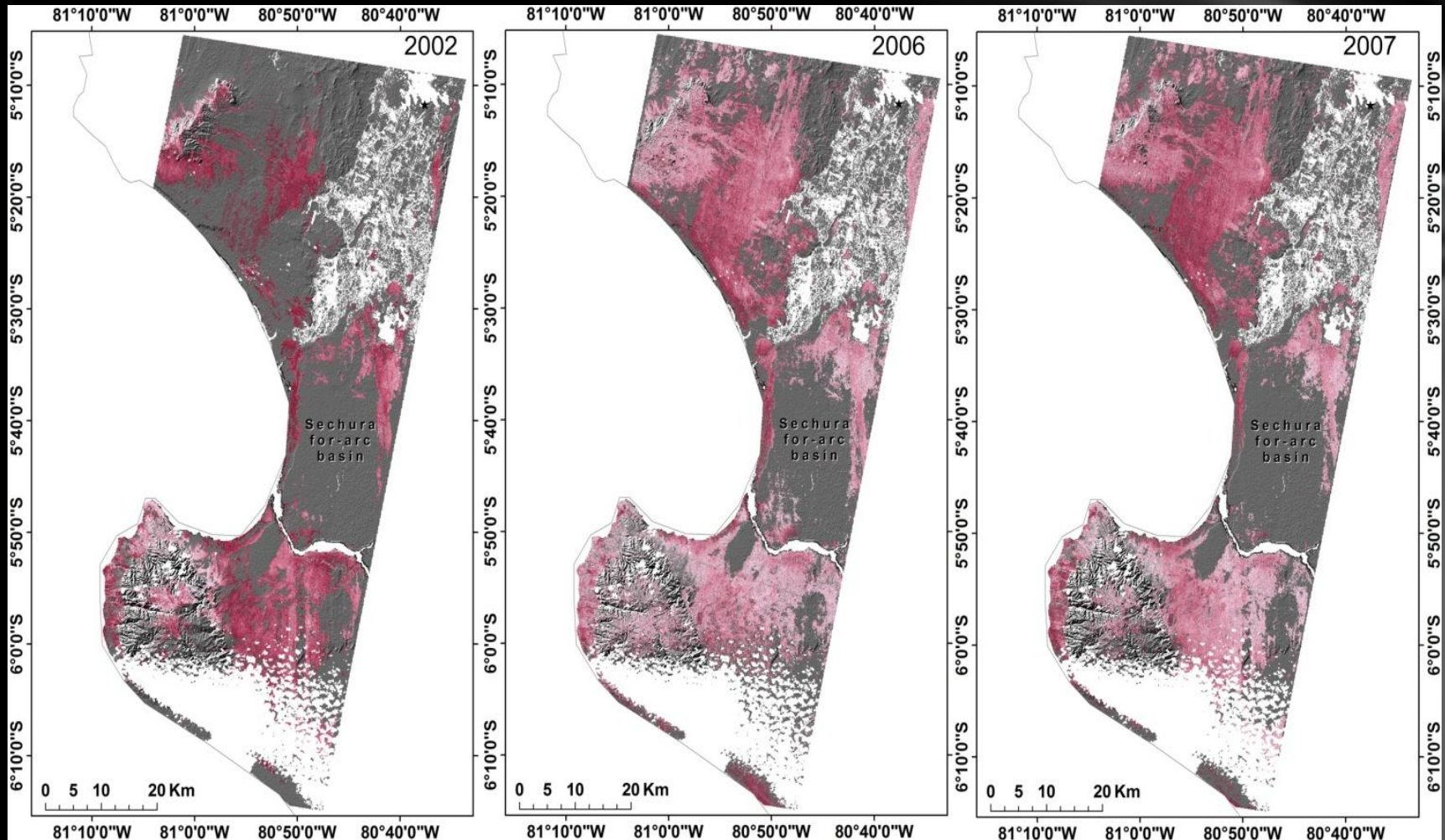
After high discharge period: formation of new evaporite sediments

# Aeolian deposits: spatio-temporal changes (2002-2007)



Aeolian deposits: spatio-temporal changes (2002-2007) in calcite fractional abundances.

# Aeolian deposits: spatio-temporal changes (2002-2007)



Aeolian deposits: spatio-temporal changes (2002-2007) in illite fractional abundances.

# Ukončené projekty: El Salvador

## Slope dependent morphometric analysis as a tool to reconstruction of volcano evolution

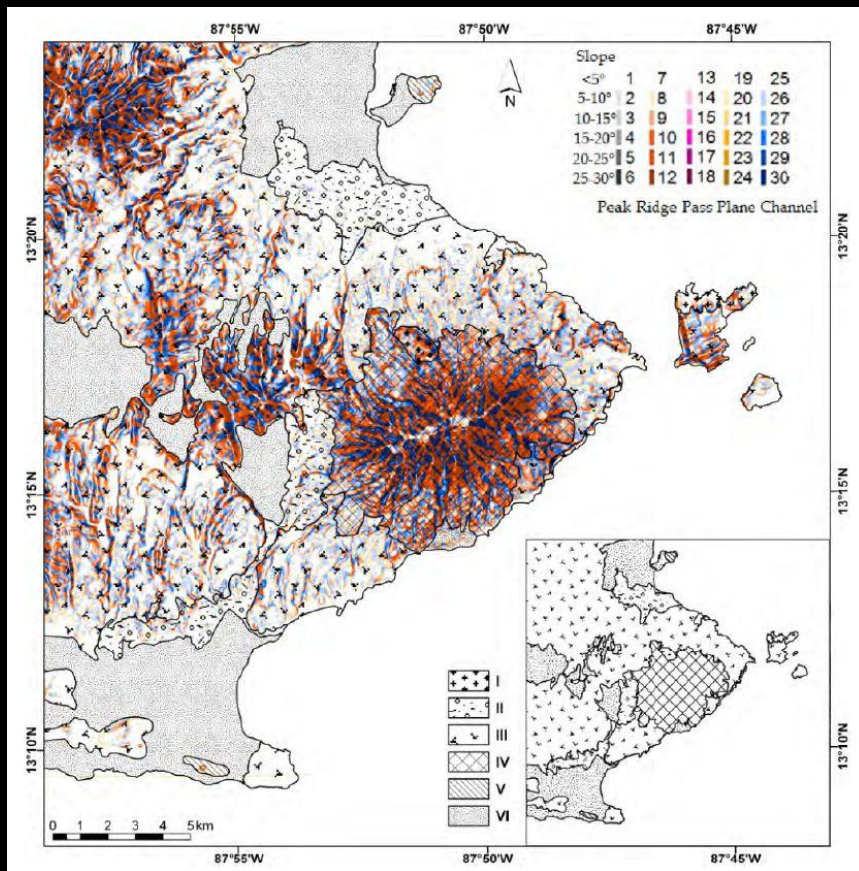
- El Salvador
- Conchagua volcano
- 10 m DEM derived from 1:25000 topographic maps



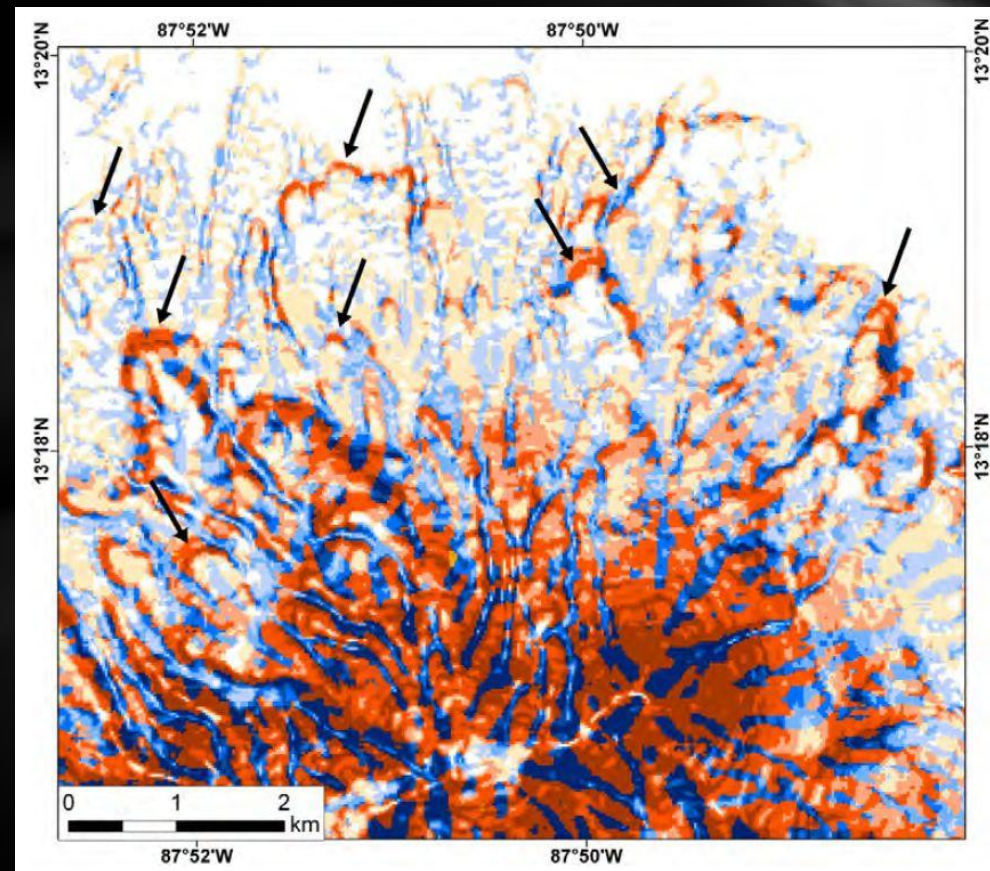
Kopačková, V., Rapprich, V., Zelenková, K., Šebesta, J.: Slope dependent morphometric analysis as a tool contributing to reconstruction of volcano evolution, In Dar I.A: Earth and Environmental Sciences, s. 220-240. – InTech Open Access, ISBN 978-953-307-468-9.

# Ukončené projekty: EL SALVADOR

## Slope dependent morphometric analysis as a tool to reconstruction of volcano evolution



Slope dependent morphometric map and morphometric units



Detail of the lava flow fronts (black arrows) from the slope-dependent morphometric map

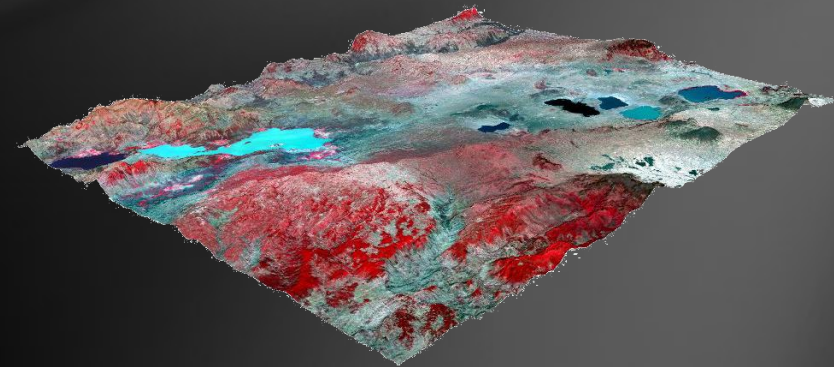
# Ethiopia (2012-2014)

## Focus of the project:

- Funded by Czech Development Agency
- Capacity development of the Geological survey of Ethiopia (GSE) staff (using of modern technologies)
- Dealing with
  - Engineering geology
  - Mapping of ground water resources
  - Natural hazards

## Test sites:

- Dila and Hosseina



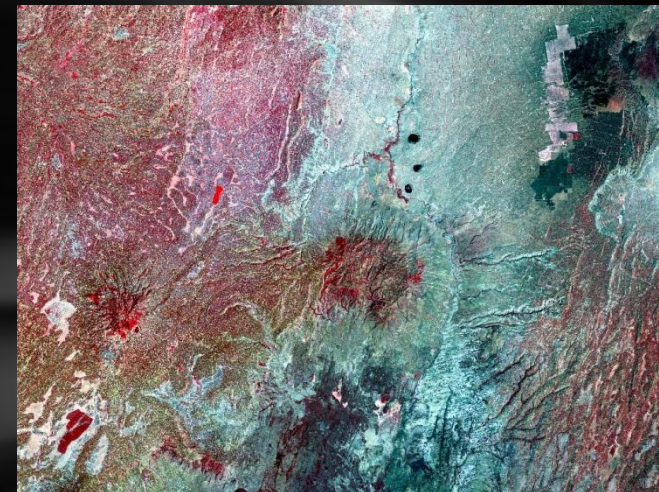
# Ethiopia (2012-2014)

## Role of RS:

- Preparation of supportive maps and other RS derivatives for the field survey



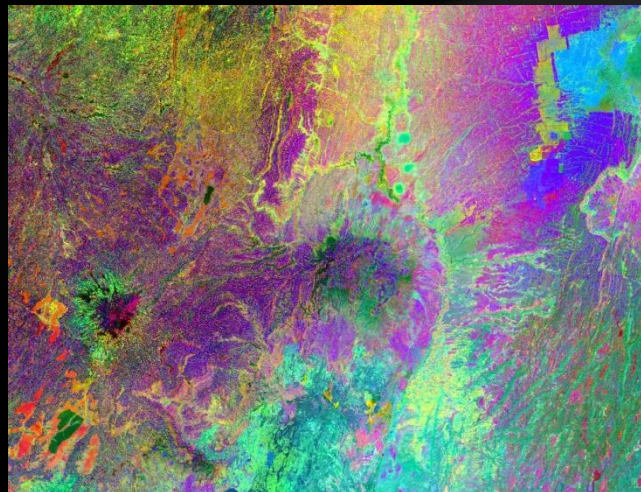
true RGB



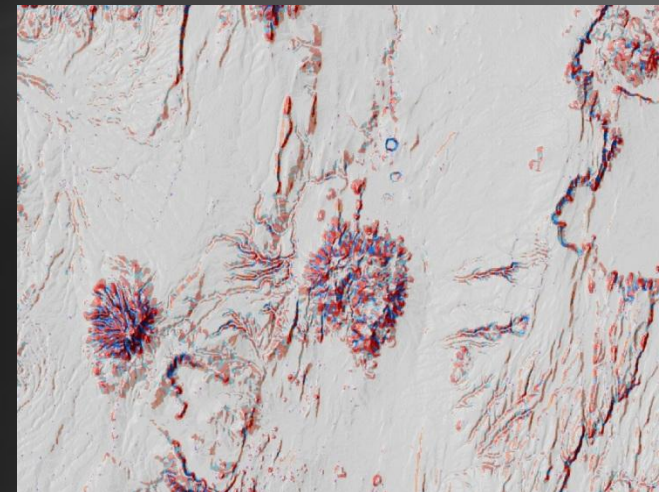
CIR

## Data:

- ASTER
- Landsat ETM+
- SRTM-DEM

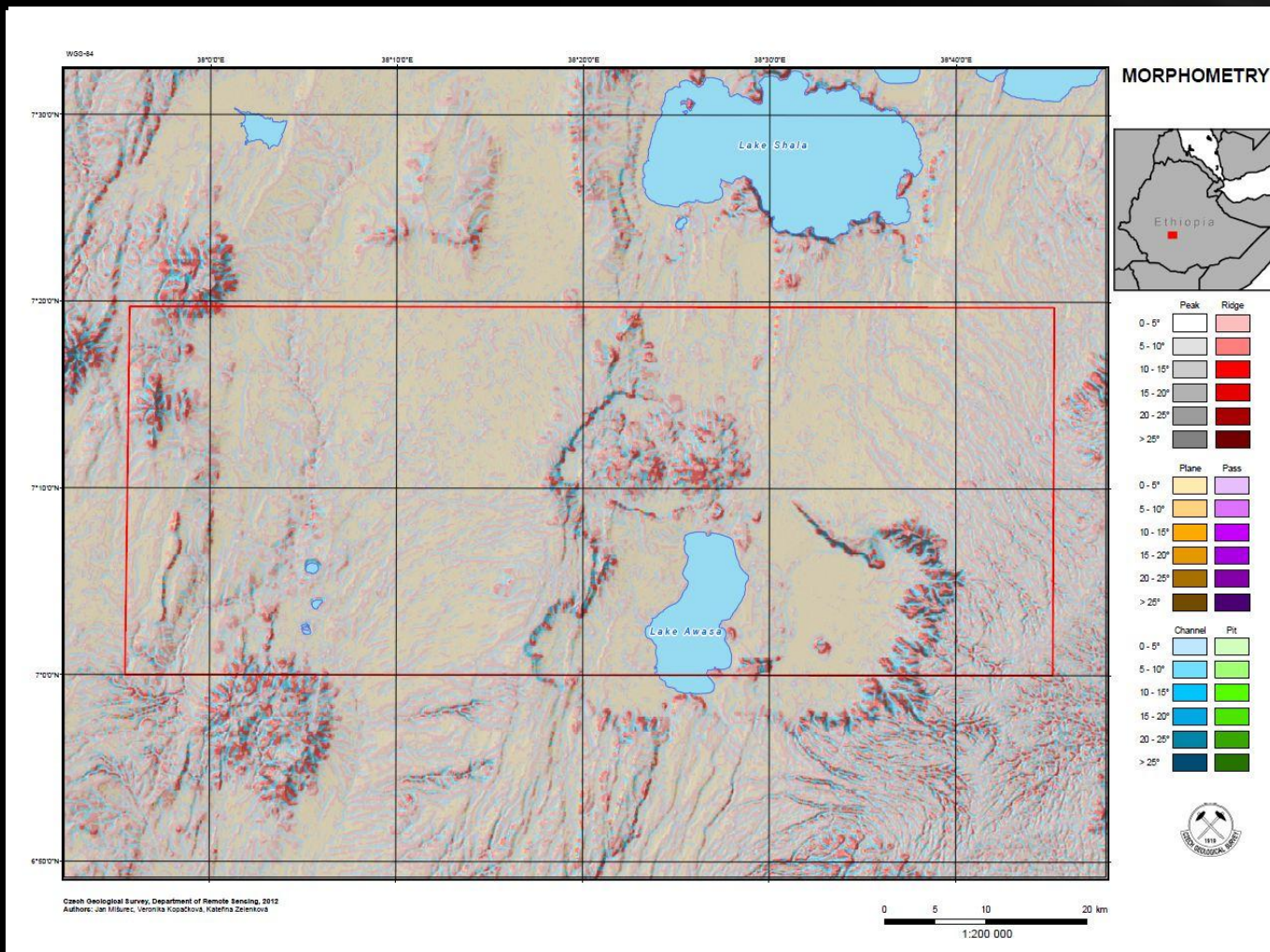


PCA transformation



terrain morphology

# Ethiopia (2012-2014)





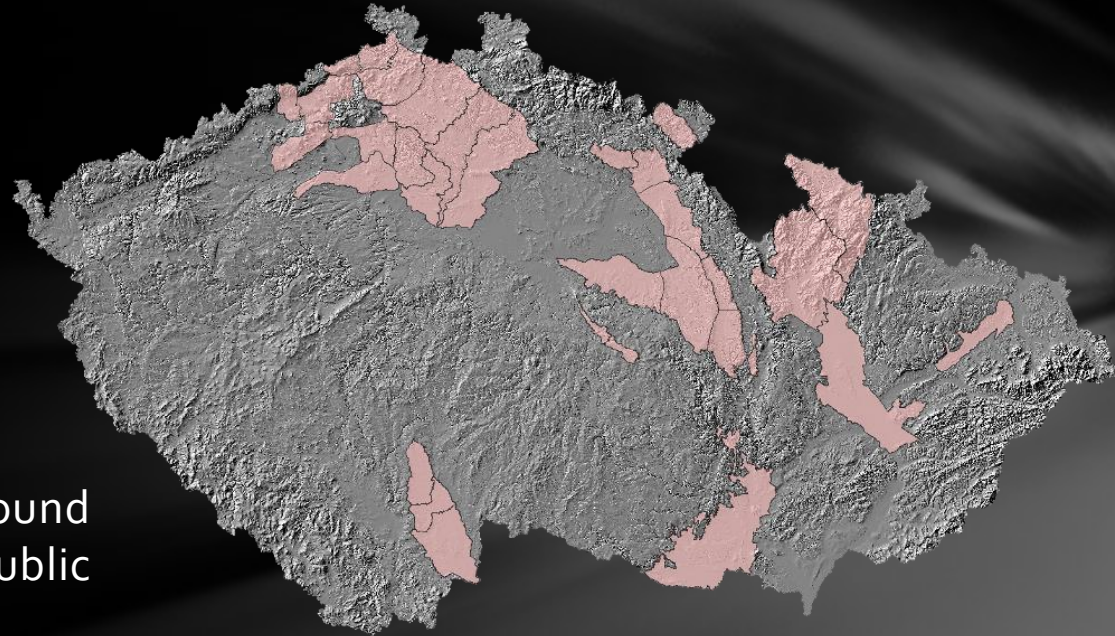
# Hydrogeologické rebilance (2010-2015)

## Primary investigator:

- Petr Mixa (CGS)
- Renáta Kadlecová (CGS)

## Focus of the project:

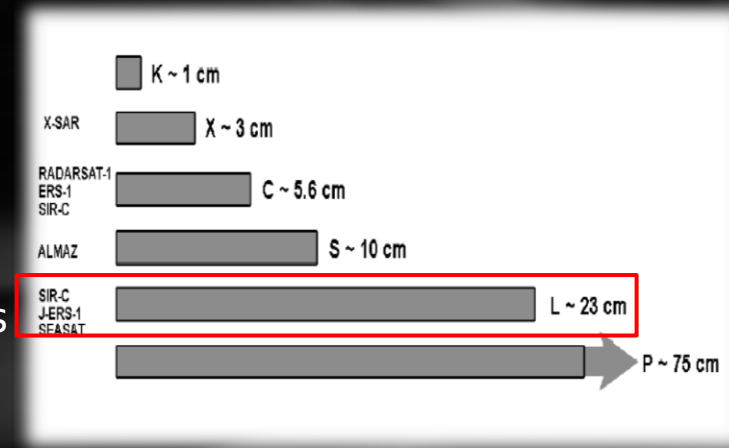
- Re-evaluation of the current ground water reserves in the Czech republic
- Updating and improvement of the current hydrogeological models by the use of the latest technologies



# Hydrogeologické rebilance (2010-2015)

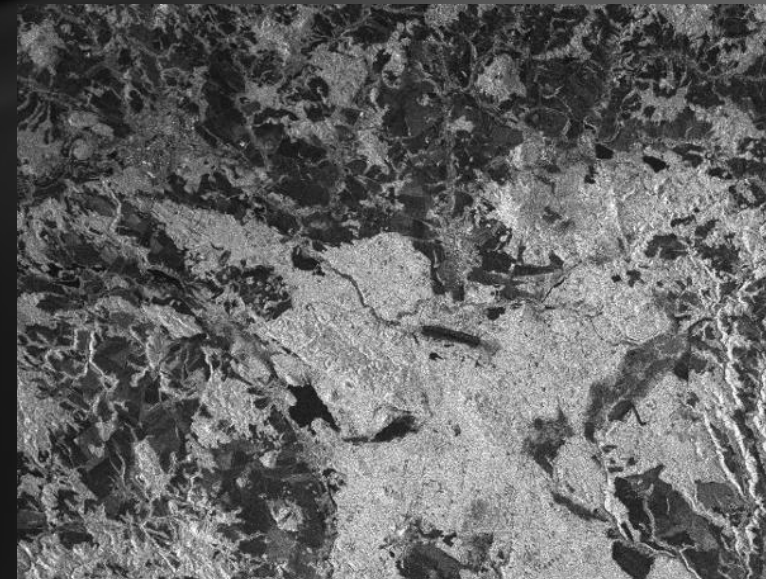
## Main objectives (only RS part):

- Extraction and interpretation of the linear structures connected with the brittle tectonics, terrain morphology and fault systems
- Morphotectonical interpretations using gradients of surface dielectric properties derived from SAR data.

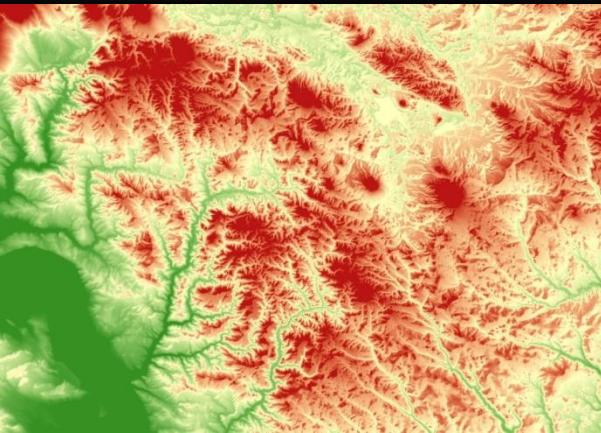


## Data:

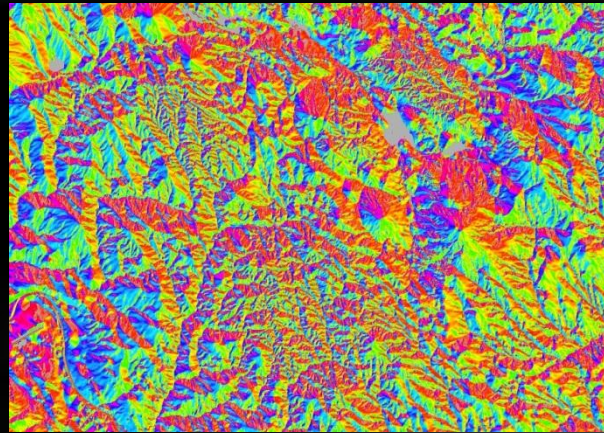
- **ALOS/PALSAR**
  - L-band (wavelength 23 cm, resolution 12.5 m)
- **DEM and its derivatives**
  - Slope
  - Aspect
  - Shaded relief
  - Morphological features extraction



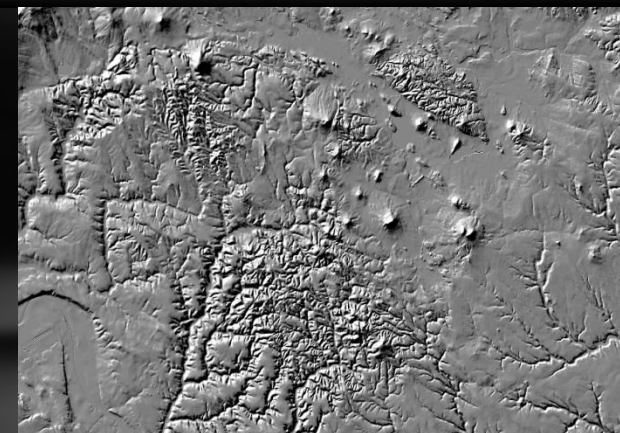
# Hydrogeologické rebilance (2010-2015)



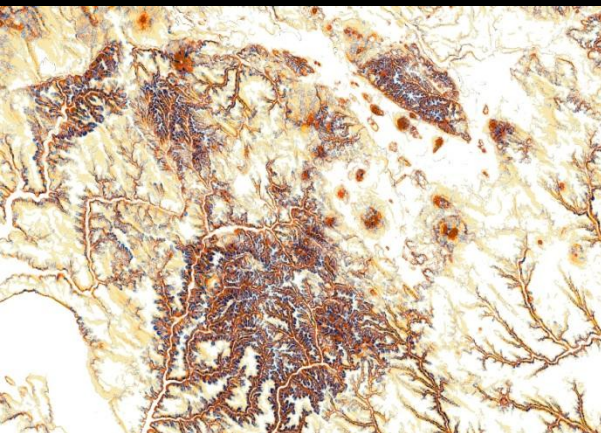
Digital Elevation Model



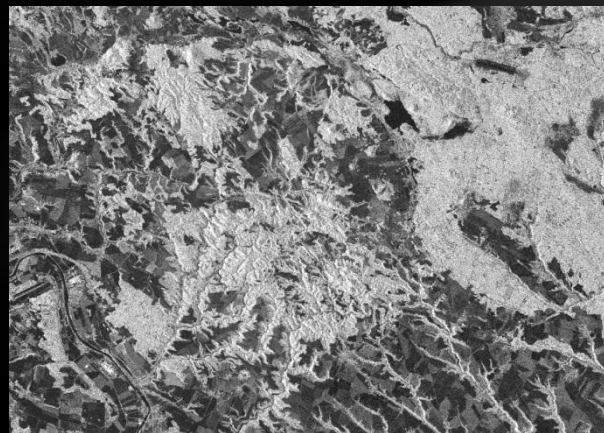
Aspect



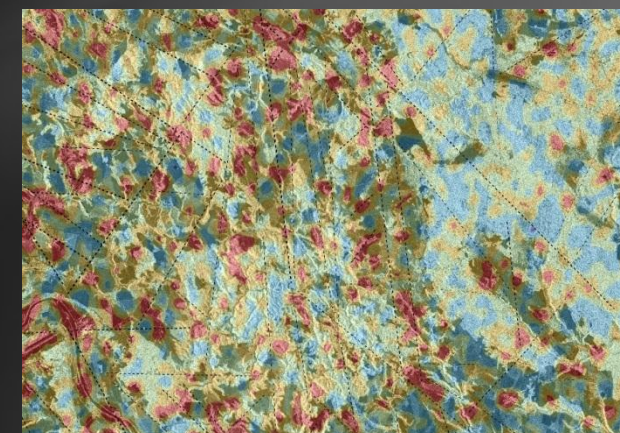
Shaded relief



Morphological features  
extraction

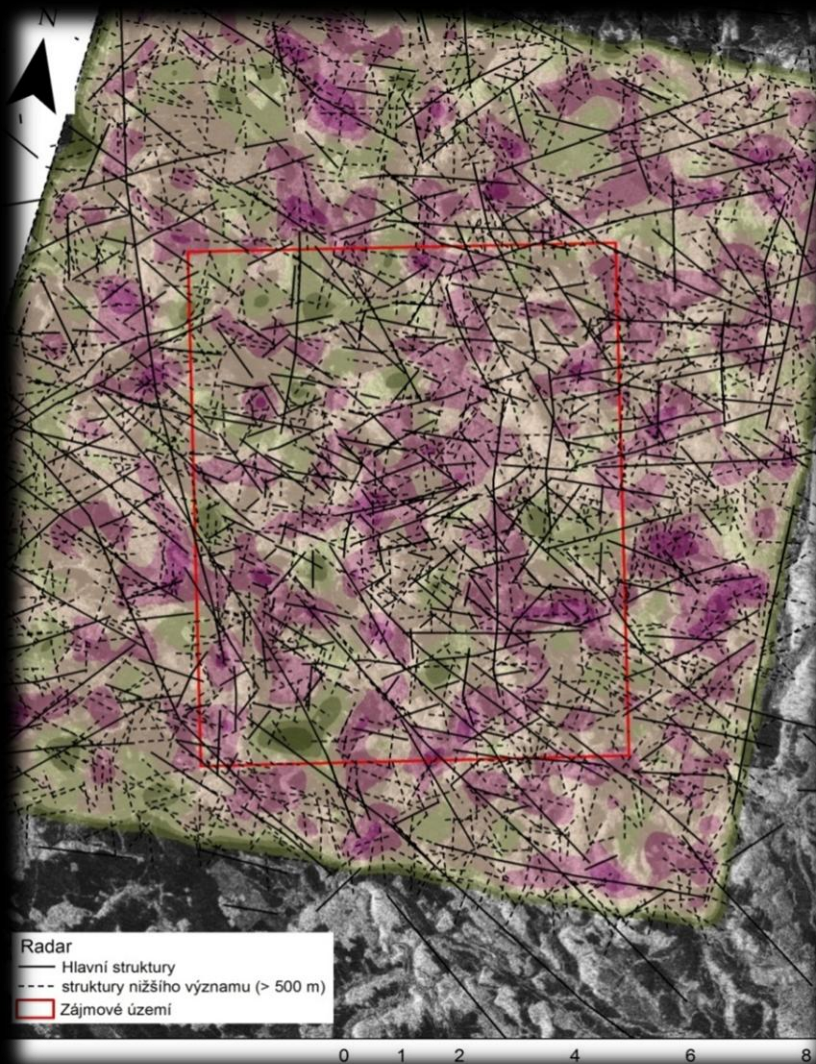


ALOS/PALSAR



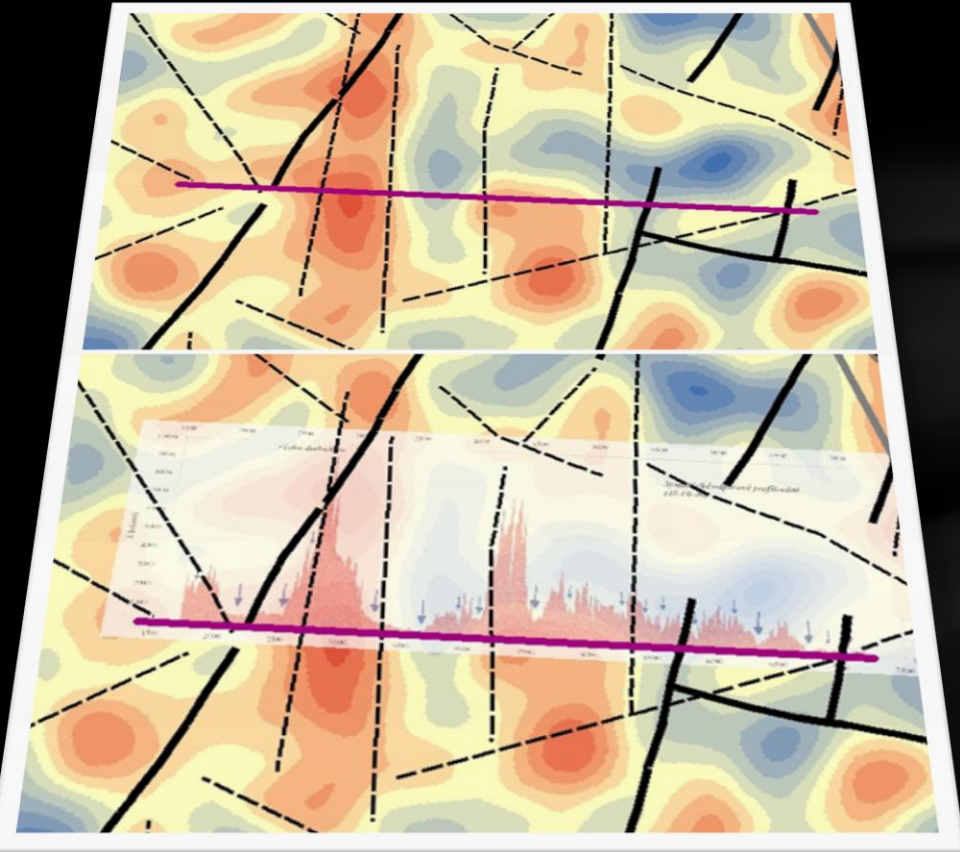
Linear feature spatial frequency  
and final interpretation

# Hydrogeologické rebilance (2010-2015)



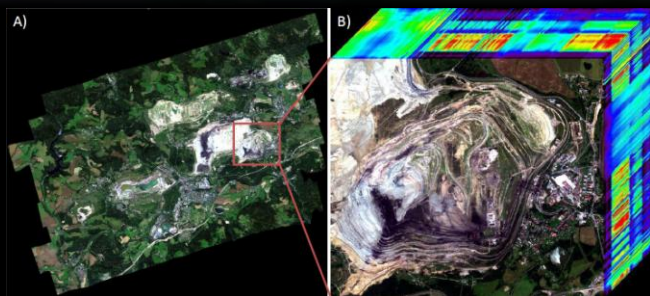
Plošná změna frekvence hustoty liniových vektorů identifikovaných na podkladě radarových dat interpretované lineární strukturní indicie (v rámci rastru se hustota mění od nízké (zelená) po vysokou (fialová)).

# Hydrogeologické rebilance (2010-2015)



Na profilu (fialová linie) bylo realizováno odporové měření (G IMPULS) metodou symetrického odporového profilování (SOP). Velmi dobrá shoda s výsledky z geofyzikálního profilování s hustotními zónami (derivovány z radarových dat ALOS PALSAR) a jejich interpretovanými významnými rozhraními

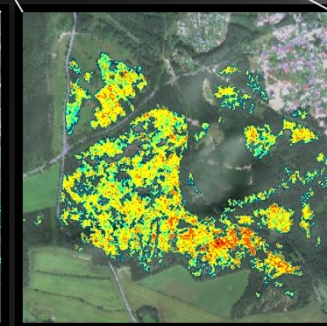
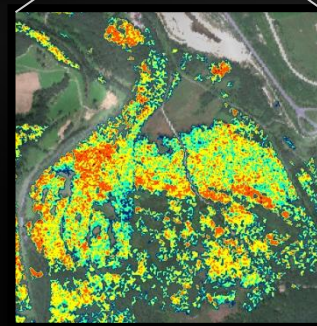
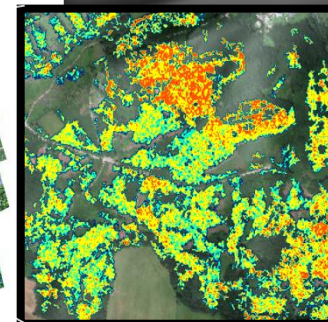
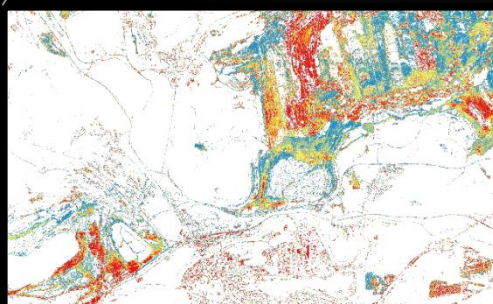
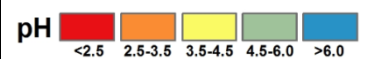
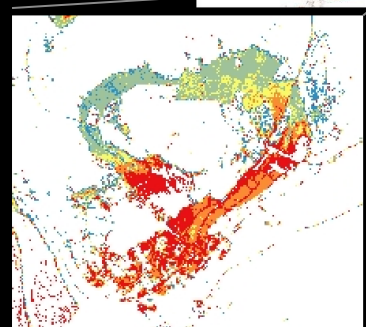
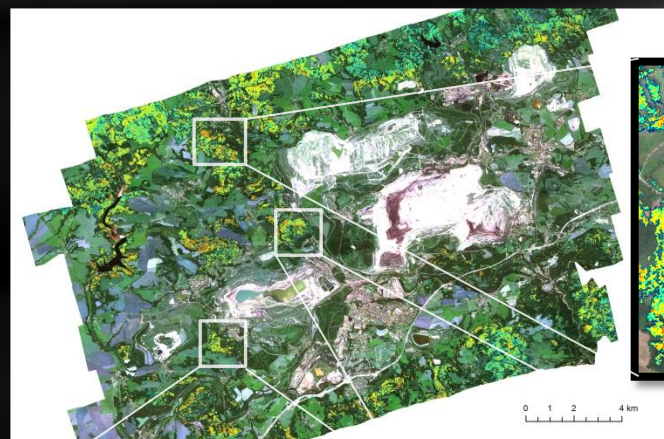
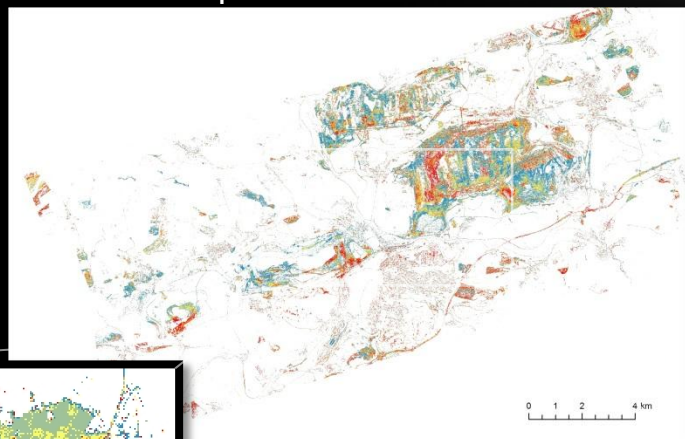
# Hyperspektrální aplikace



Sokolovská pánev:  
letecká data HyMap (07/2009)

Povrchové pH

Zdraví smrkových porostů



# Přínos dat Copernicus

- **Sentinel 2** (VIS/VNIR/SWIR; 4b,6b, 3b; 10 m, 20 m, 60 m) :
  - VIS/VNIR pásma umožňující analýzu chlorofylu : geo-environmentální aplikace
  - SWIR: minerální složení, mapování geologie a půda
- Obecně lepší spektrální rozlišení než data dostupná v této chvíli
- Možnost přenesení vybraných hyperspektrálních aplikací z úrovně lokálních „case-studies“ na regionální úroveň, velký potenciál do oblasti monitoringu

# Děkujeme za pozornost



Česká geologická služba

Remote Sensing Unit

Klárov 3

Prague 1

118 21

Czech republic

[www.remotesensing-geology.ic.cz](http://www.remotesensing-geology.ic.cz)