InSAR-based infrastructure monitoring results in the regional GeoSES project

Presenter: Balint Magyar[1][2]

Co-author: Roland Horvath[2]

[1] Budapest University of Technology and Economics – Faculty of Civil Engineering – Department of Geodesy and Surveying
[2] Lechner Nonprofit Ltd. - Satellite Geodetic Observatory

In: GISopen 2022,, *2022.09.02. 11.20 (CEST)*
Óbudai Egyetem,Alba Regia Műszaki Kar
Székesfehérvár, Hungary

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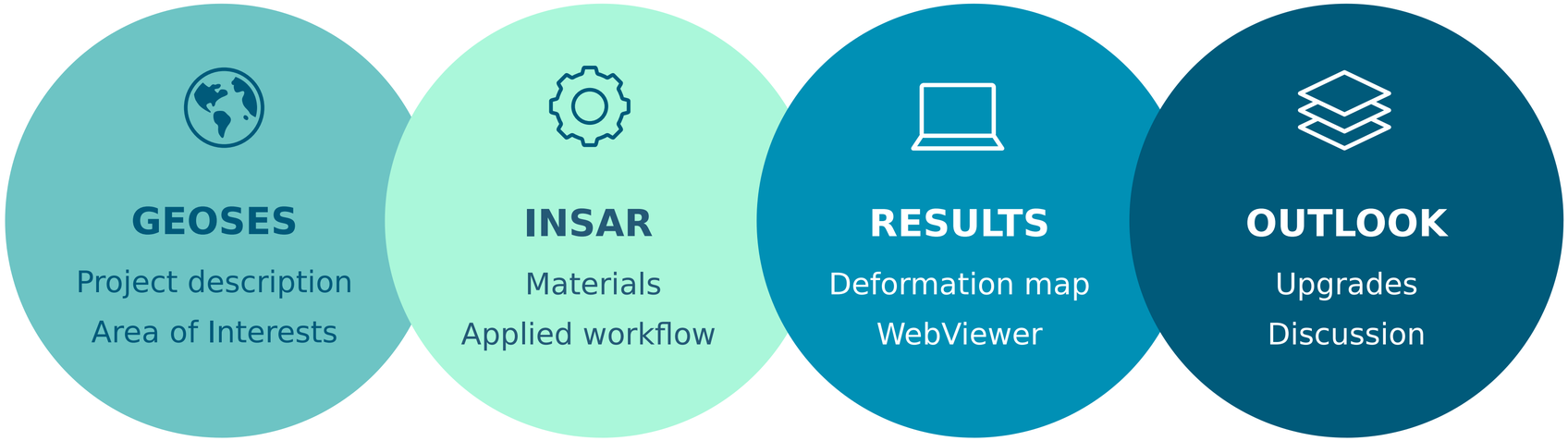
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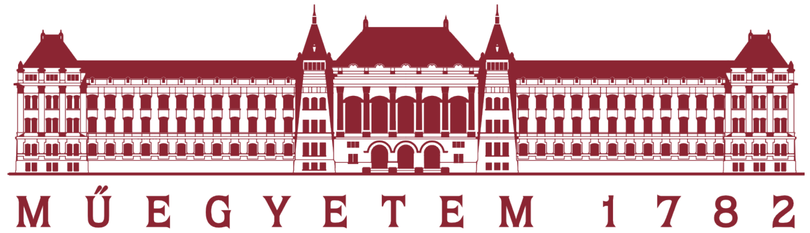
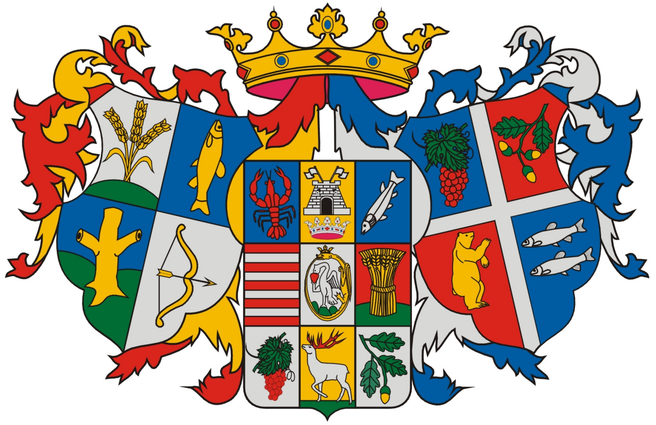
GEOSES PROJECT

Project description and Area of Interests

GeoSES Partners





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GeoSES Objectives

Dedication

- ENI Cross-border Cooperation Programme 2014-2021
- Extension of the operational Space Emergency System

Partners

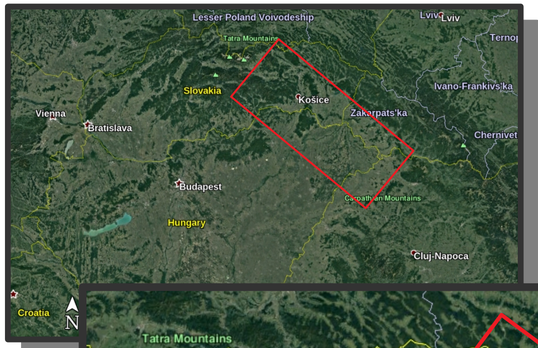
- Hungary: Self Government of SZSZB County / BME (+LTK)
- Slovakia (UPJS), Romania (UTC-N) , Ukraine (UZHNU - lead)

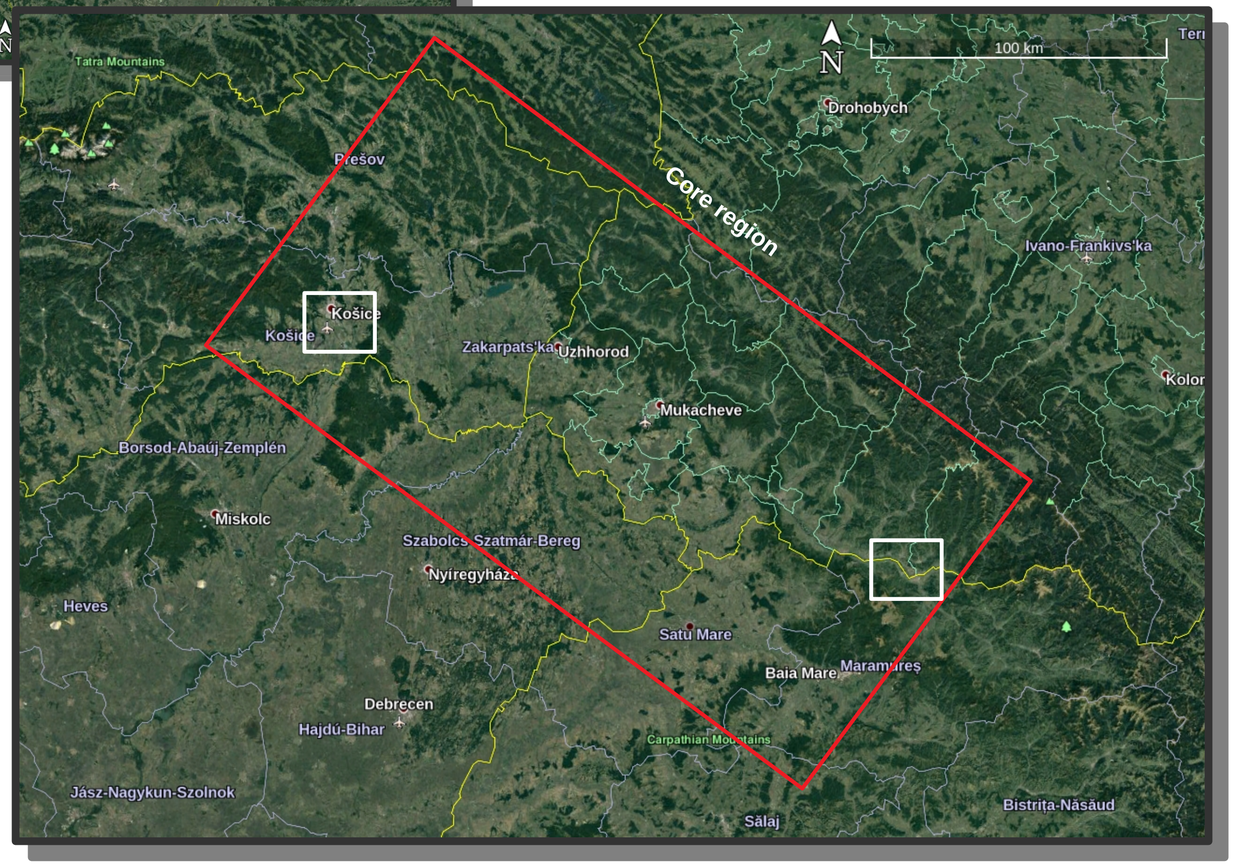
Specified objectives

- Monitoring natural and anthropogenic geo-processes
- Integration innovative and advanced techniques, including EO with InSAR

InSAR specific roles AG 1.

- Processing chain development and PSI analysis (AOIs – Requests of Partners', preliminary, core region)
- Deformation map and database





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GeoSES

GeoSES - HUSKROUA/1702/8.1/0065

GeoSES Project: InSAR Timeline

T0: start of project
Grant Contract (**2019.11**)

START PROJECT

Planned start of Activity 1.2: T0+4

2020.11

Realization of HW procurement
LTK Software integration
Data migration (**WORK START T0+12**)

Preliminary PSI of AOIs aiming field Measurements, Report to project team

2021.04

2022.04

Regional processing workflow development, First presentation of regional results

Reporting period, Preparing products
Transfer data to Beneficiaries (planned: T0+24+6)

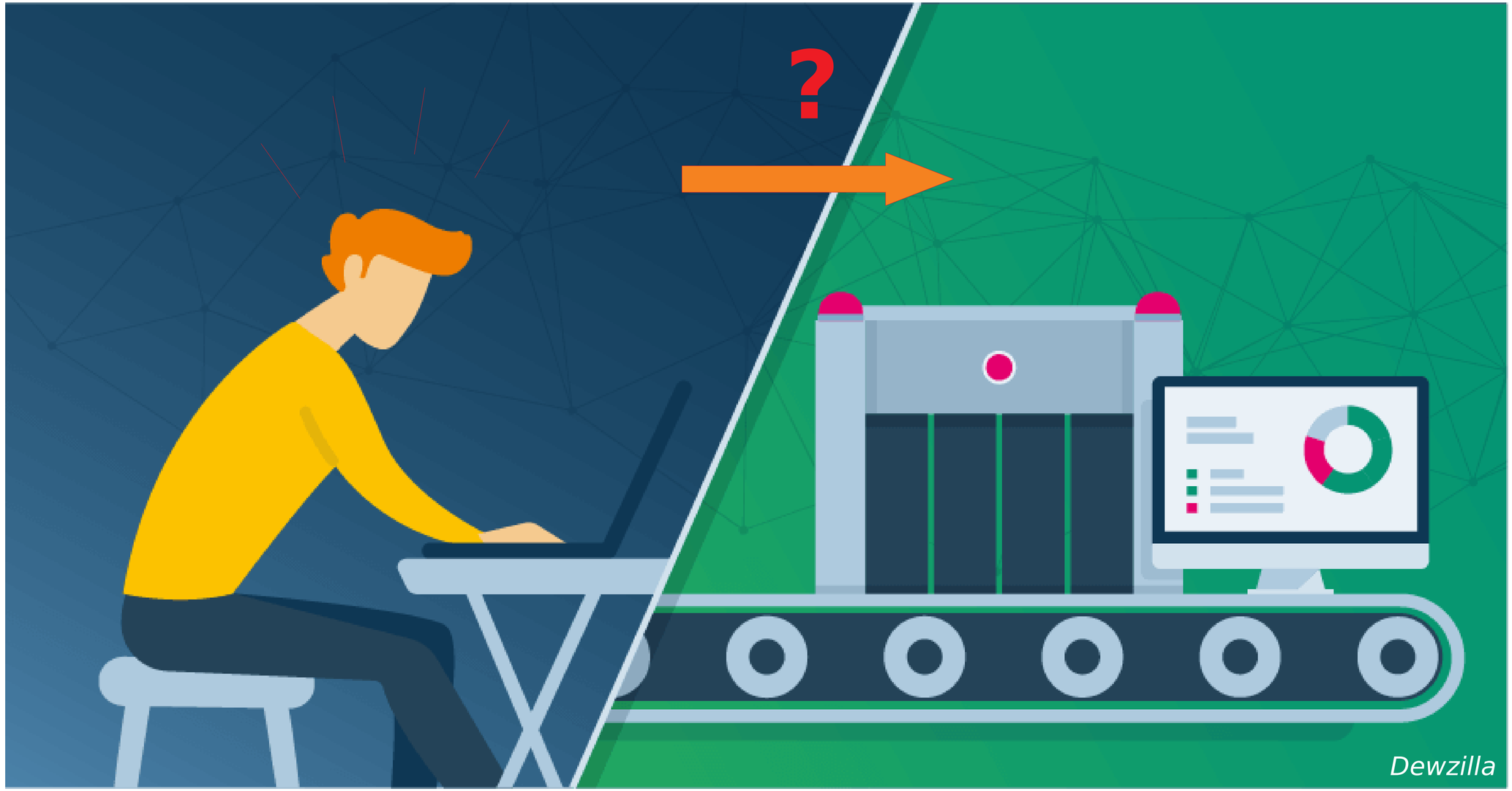
2022.05

NOTE: *HW procurement delays and Covid19 situation results to project extension (~6 months), some delay due to technical (HW+SW+WF) problems*

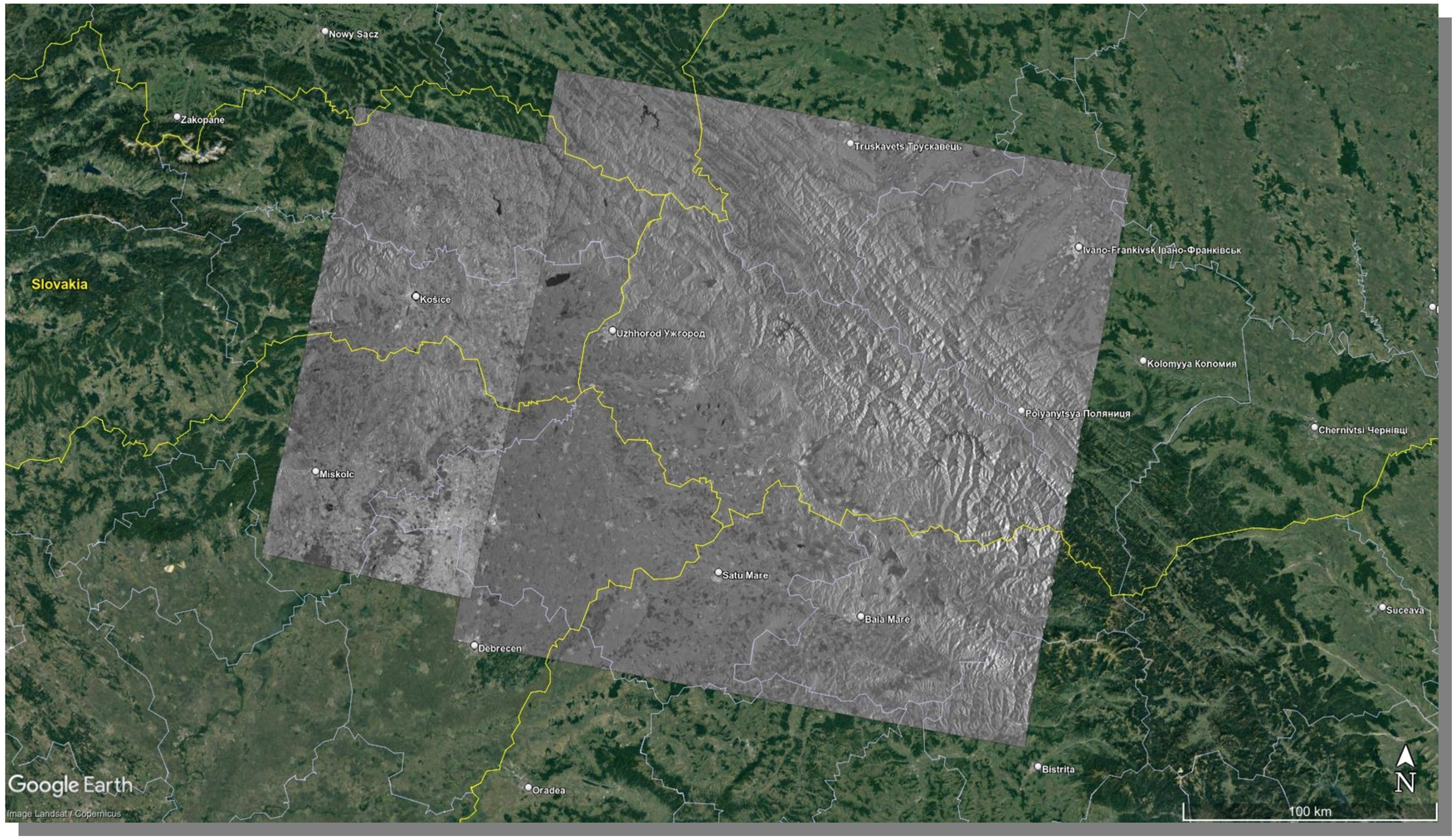
INSAR WORKFLOW

Materials and Applied Workflow

From manual to automated:



Area of Interest – SAR RMLI



Core Area

- Transcapathia (UKR)
- E-Slovakia (SLO)
- NW-Romania (ROM)
- NE-Hungary (HUN)

Characteristics

- Area: ~60 000 km^2
- Timespan: 2014-2021
- **>460 diff int / ROI**
- Single-look phases

RONs

- DESC 153
- DESC 080

GOAL:
Obtain LOS & U-D components

Input data and management

SAR Level-1 SLC products

- Interferometric researches requires SLC products
- Copernicus Schihub (archive data on request)
- Alaska Satellite Facility (ASF) – **quick access**

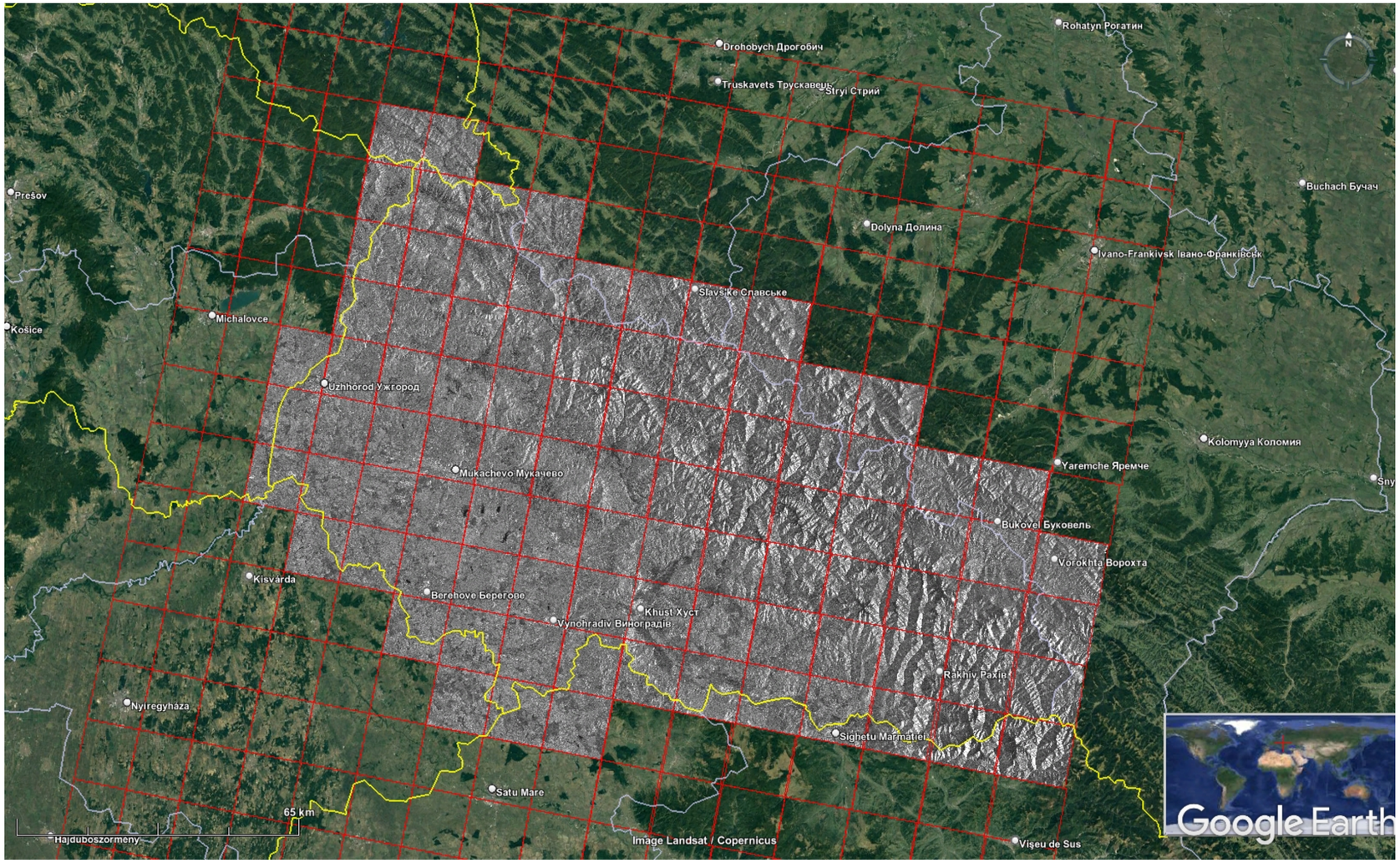
Auxiliary data

- Digital Elevation Model (DEM) 1 arcsec
- Precise orbit data
- Ground Control Points, AOI metadata

Softwares

- GAMMA Remote Sensing (all modules)
- ANACONDA + required packages
- PC: Ubuntu 18.04, SERVER: DEBIAN 10

Tiling of AOIs



Tile Characteristics

- D080 Stack is tiled to 256 imgs
- D153 Stack is tiled to 78 imgs
- approx 160km2 tiles

Full Frame Operations

- Preprocessing steps: noise Filtering, precise orbit addition
- initial geocoding
- iterative coregistration
- deramping and oversampling

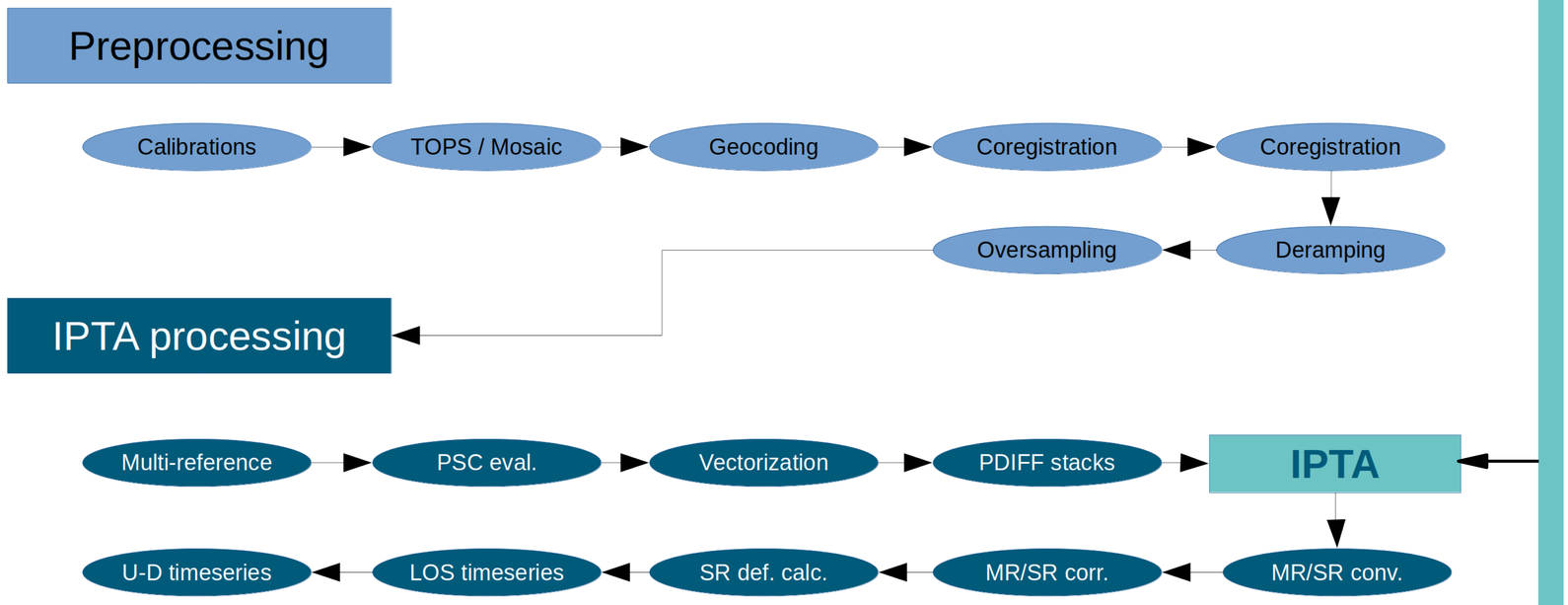
(**~1 week**, 32 CPU, 64 GB RAM)

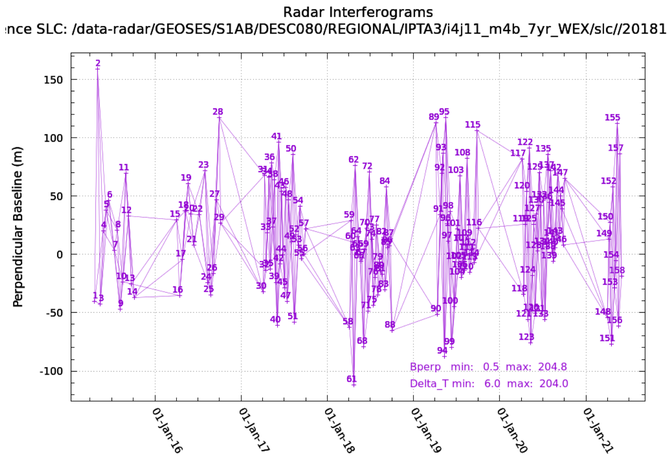
Tile Operations

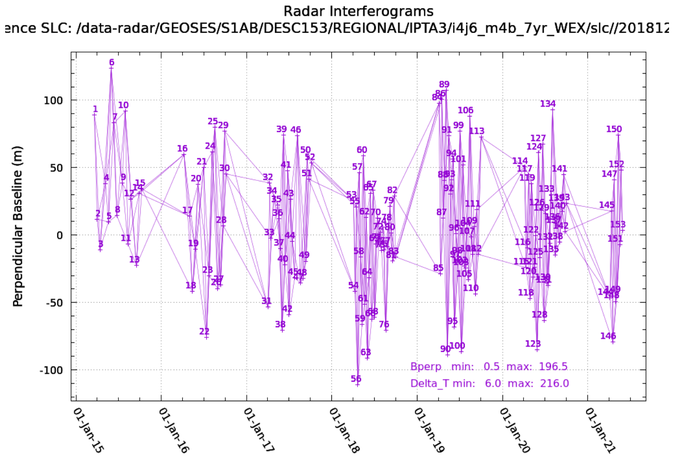
- PSC eval, IPTA, multi/single-ref
- deriving LOS and UP

(**~2 days**, 32 CPU, 64 GB RAM)

Automated workflow (MultiRef)







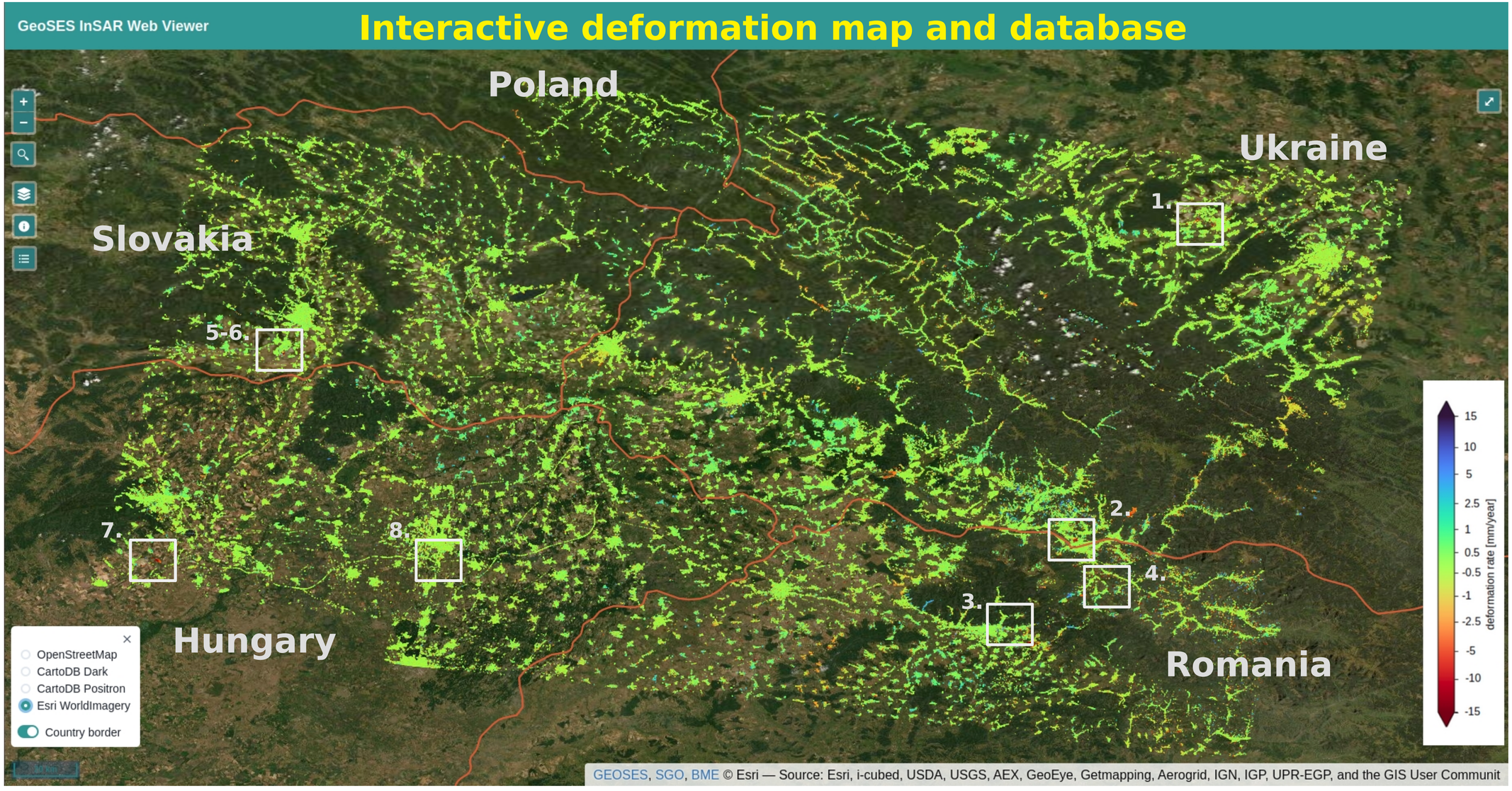
IPTA data and processing characteristics

- Regional scale processing of HUSKROUA
- Sentinel 1A and Sentinel 1B
- 158 acquisitions / RON
- Bperp < 250m, 6 days interval,
- Single look phases (SL) and Vector format
- Multi-reference stack (>460 diff intf.)
- No reduced point list application
- Automatically selected SRP
- Unwraping strategy (1D + 2D correction)
- Unwrapping error mitigation: rewrap/filt/MCF
- Applied high-level strategy:
  1. *Height correction based on multi-ref*
  2. *APS (1.8 km) estimation based on mr*
  3. *Conversion of multi-ref to single-ref*
  4. *Derive LOS and UP deformation*
- Adequate for uniform and non-uniform defs.
- Temporally smooth deformation assumed
- Snow strategy: exclude October-April data
- No temperature dependent phase correction
- No temporary and redundant point strategy

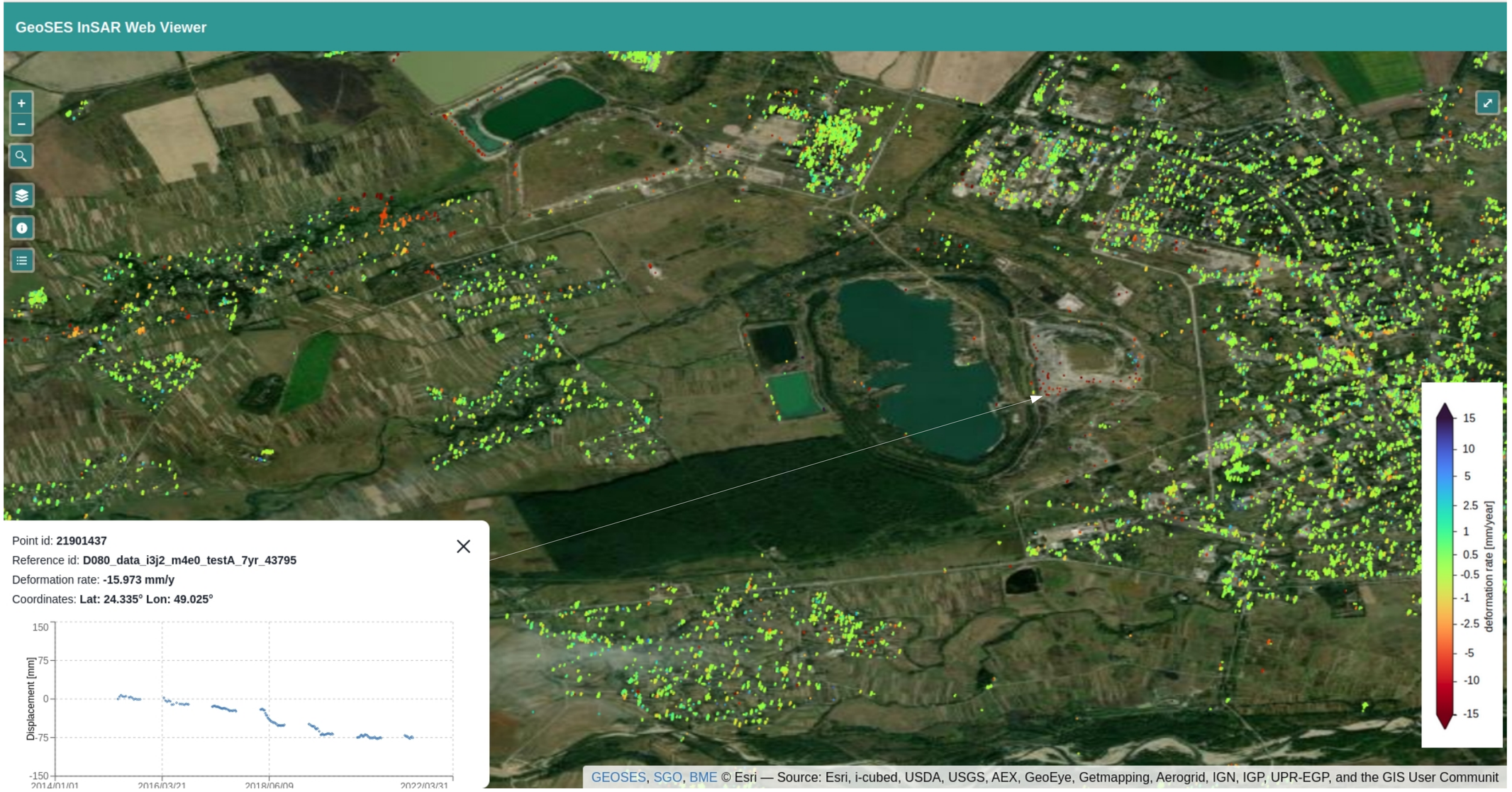
Results

Deformation map and WebViewer

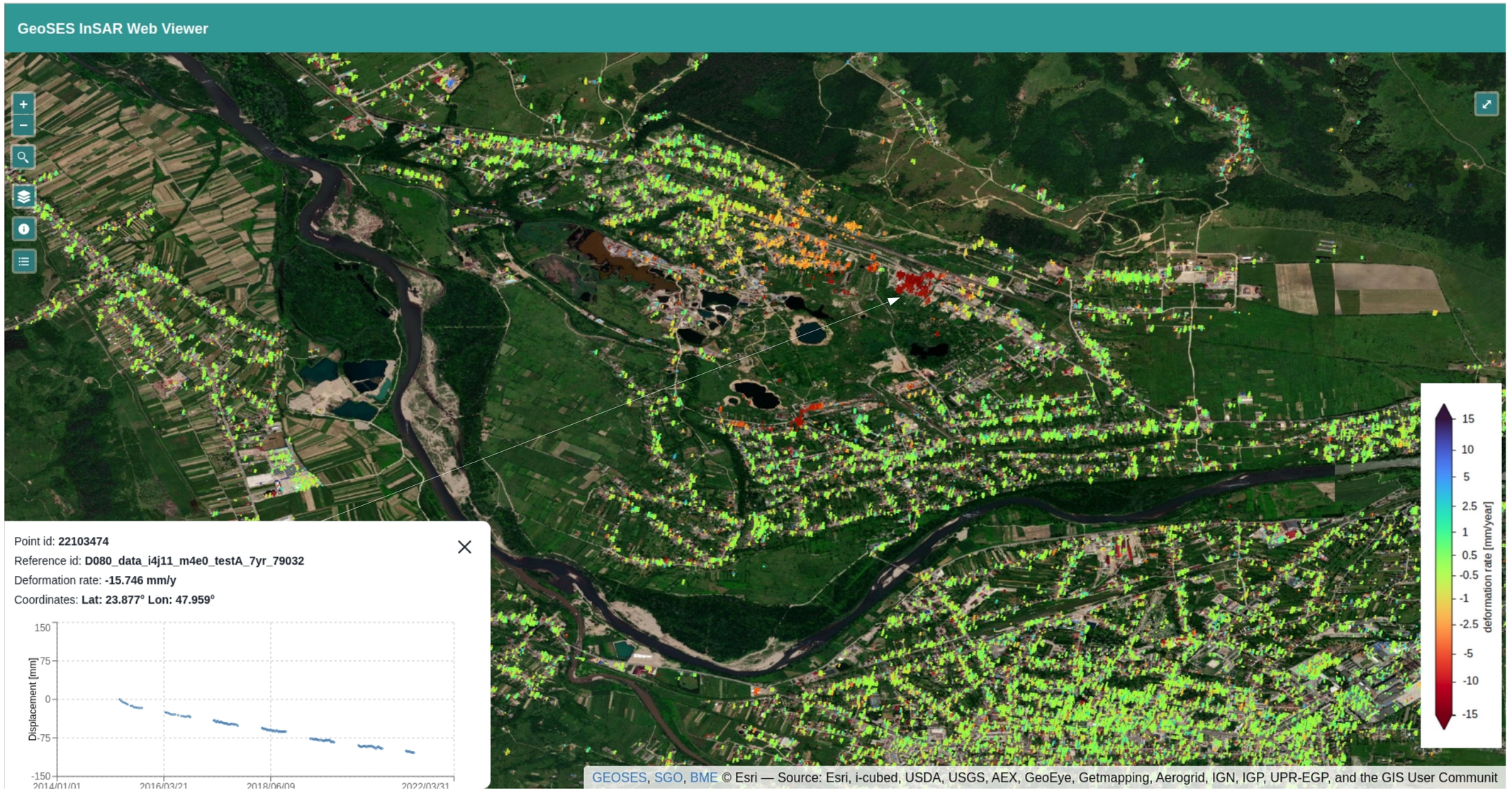
GeoSES Interactive InSAR WebViewer



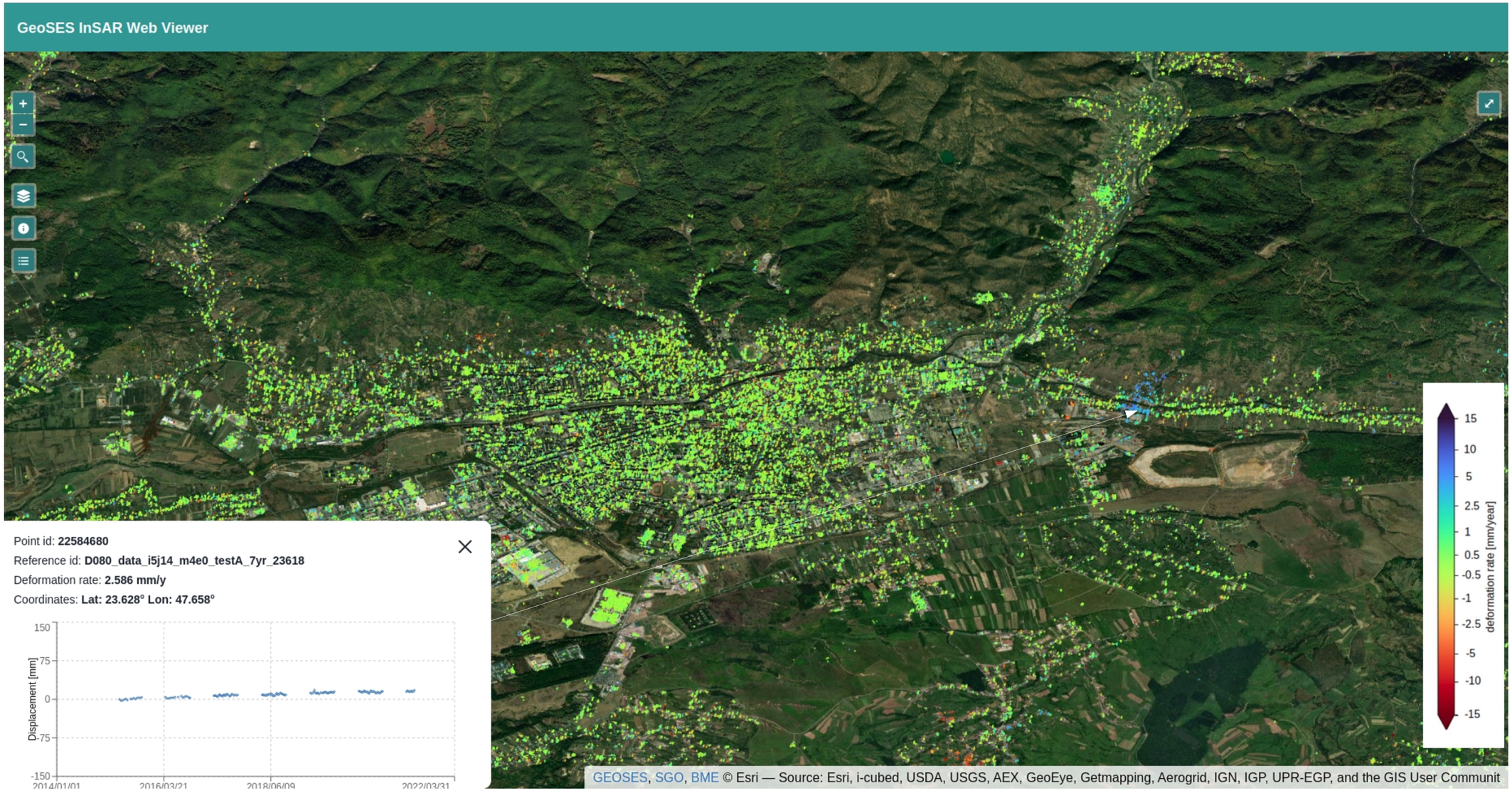
Highlighted Results 1. - Kalush (UKR)



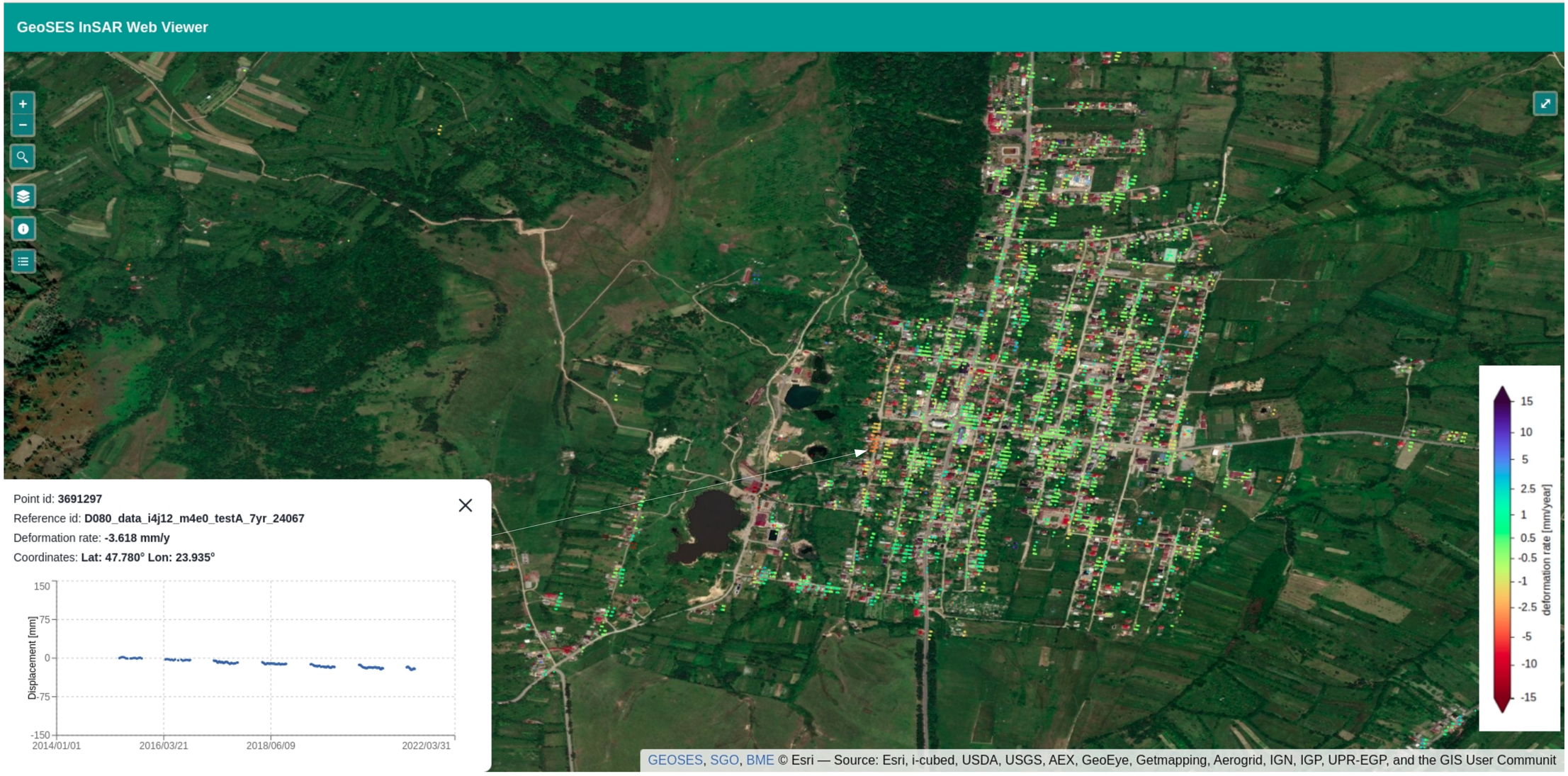
Highlighted Results 2. - Aknaszlatina (UKR)



Highlighted Results 3. - Nagybánya (ROM)



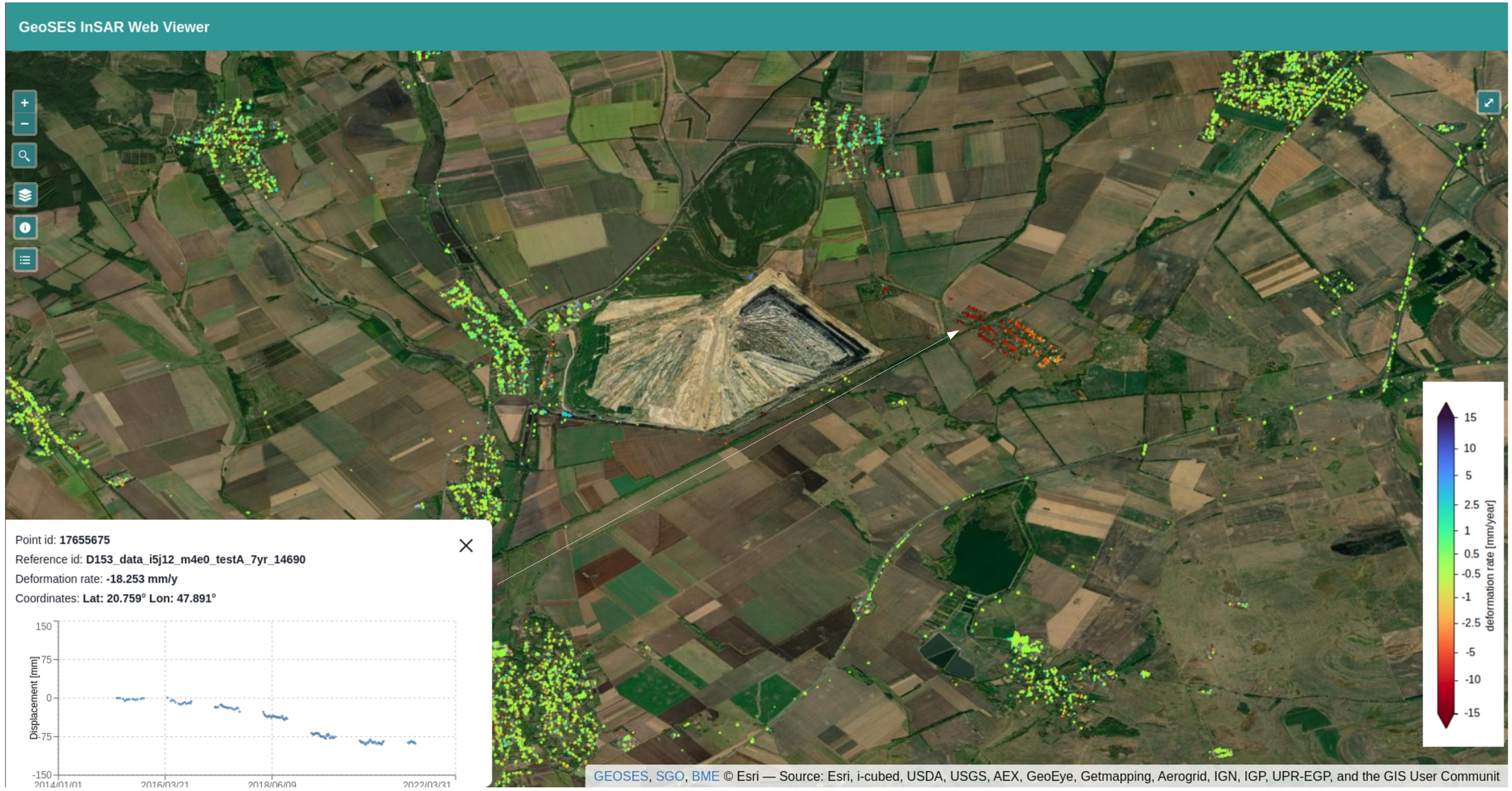
Highlighted Results 4. - Aknasugatag (ROM)



Highlighted Results 5. - Nagyida (SLK)

Highlighted Results 6. - Kassa Airport (SLK)

Highlighted Results 7. - Csincse (HUN)



Highlighted Results 8. - Nyíregyháza Ipari Park (HUN

Outlook

Upgrades and discusssion

Discussion

Single-phase and multi-reference regional PSI analysis were performed in the HUSKROUA Region

Related automated processing workflows have been presented

Output products: descending LOS deformation and converted vertical displacement time series

InSAR related Activity Group outputs and result are finalized. All products and documentation will be reported until **end of May of 2022**

WebViewer serves as **Deformation Map and Database** to disseminate (public) and distribute results within and out of the GeoSES project.

All data/database are located in BME-AFGT GeoSES Server (physically located in SGO). All processed data/database are available on request.

Planned and scheduled updates in the next 2 years.

Further development directions

Increase spatial density of PS points, involve SBAS points, test statistical homogenity based approaches, integrate ZTD data etc.

Further expansion of features and user privileges of the introduced WebViewer

Acknowledgment

Prepared with the professional support of the Doctoral Student Scholarship Program of the Co-operative Doctoral Program of the Ministry for Innovation and Technology from the source of the National Research, Development and Innovation Fund.

This research was co-financed by the HUSKROUA ENI CBC 2014-2020 Programme and it directly linked to the HUSKROUA/1702/8.1/0065 GeoSES project.

Thank you for the technology and software related consultancies and insights for Urs Wegmüller

Thank you for the research related consultancies for Lajos Völgyesi[2], Szabolcs Rózsa[2] , Béla Paláncz[2] and Ambrus Kenyeres[1]

Discussion: Q&A

Thank you for your attention!

Contacts

Balint Magyar

00 36 27 200 802

magyar.balint@emk.bme.hu / balint.magyar@lechnerkozpont.hu

www.sgo-penc.hu

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