

Danijel Šugar

# EO4GEO training: Fast disaster response – satellite technologies for surface displacement monitoring

**GNSS**

July 12<sup>th</sup> – 14<sup>th</sup>, 2021

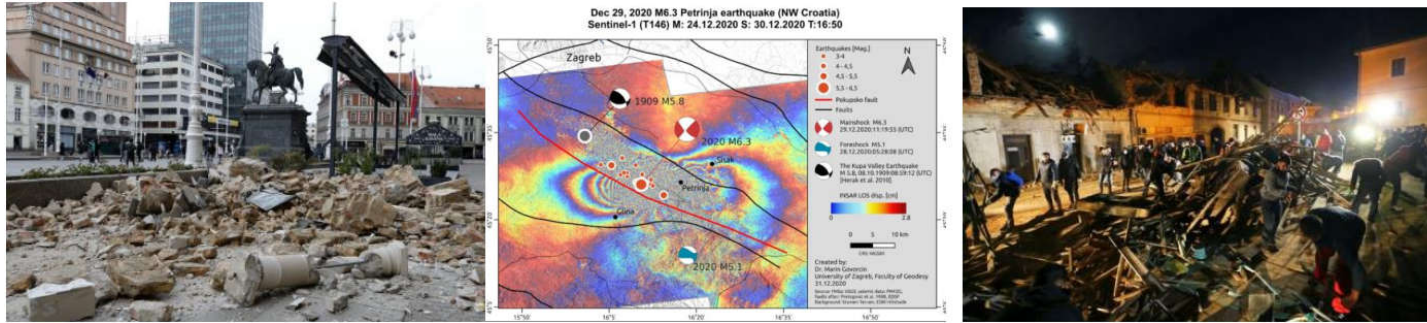


University of Zagreb – Faculty of Geodesy

EO4GEO training 13 & 14 July 2021



Co-funded by the Erasmus+ Programme of the European Union



Danijel Šugar

**EO4GEO training: Fast disaster response – satellite technologies for surface displacement monitoring**

**Displacement of CROPOS SISA station in the period 27<sup>th</sup> December 2020 – 6<sup>th</sup> January 2021 assessed by GNSS PPP & Static Relative Positioning method**



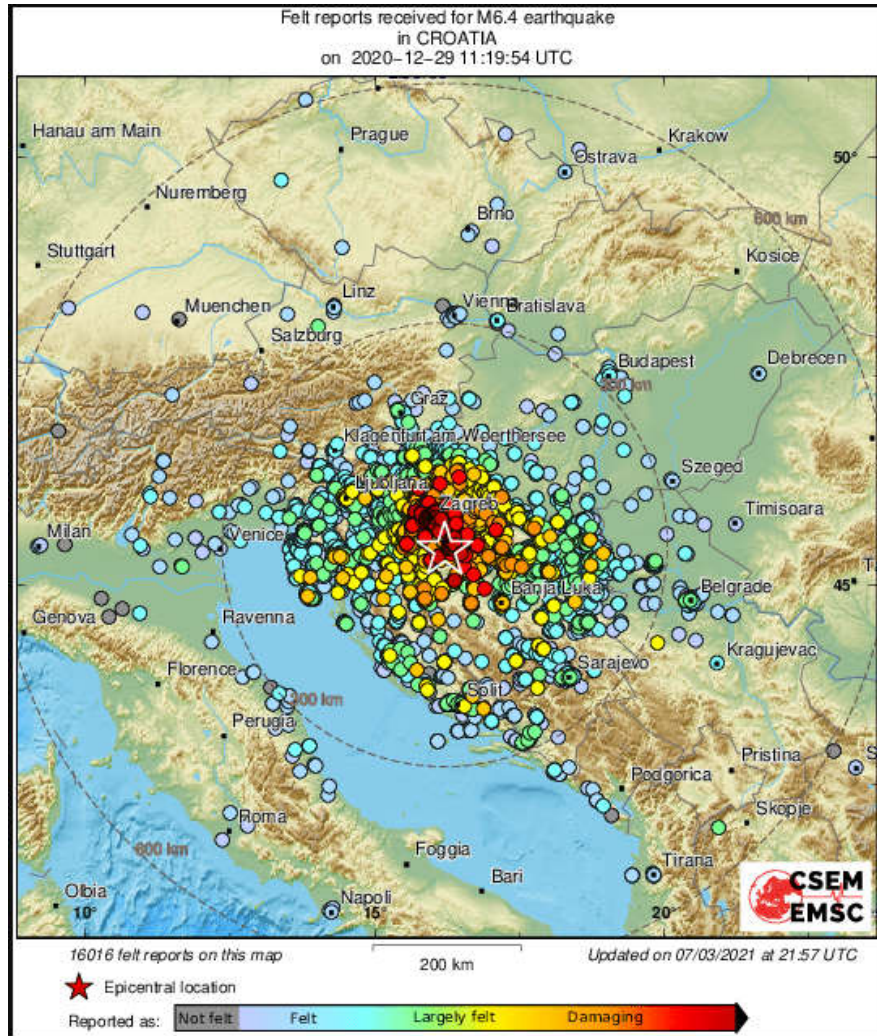
**University of Zagreb – Faculty of Geodesy**

E04GEO training 13 & 14 July 2021



Co-funded by the Erasmus+ Programme of the European Union

# Motivation instead of introduction



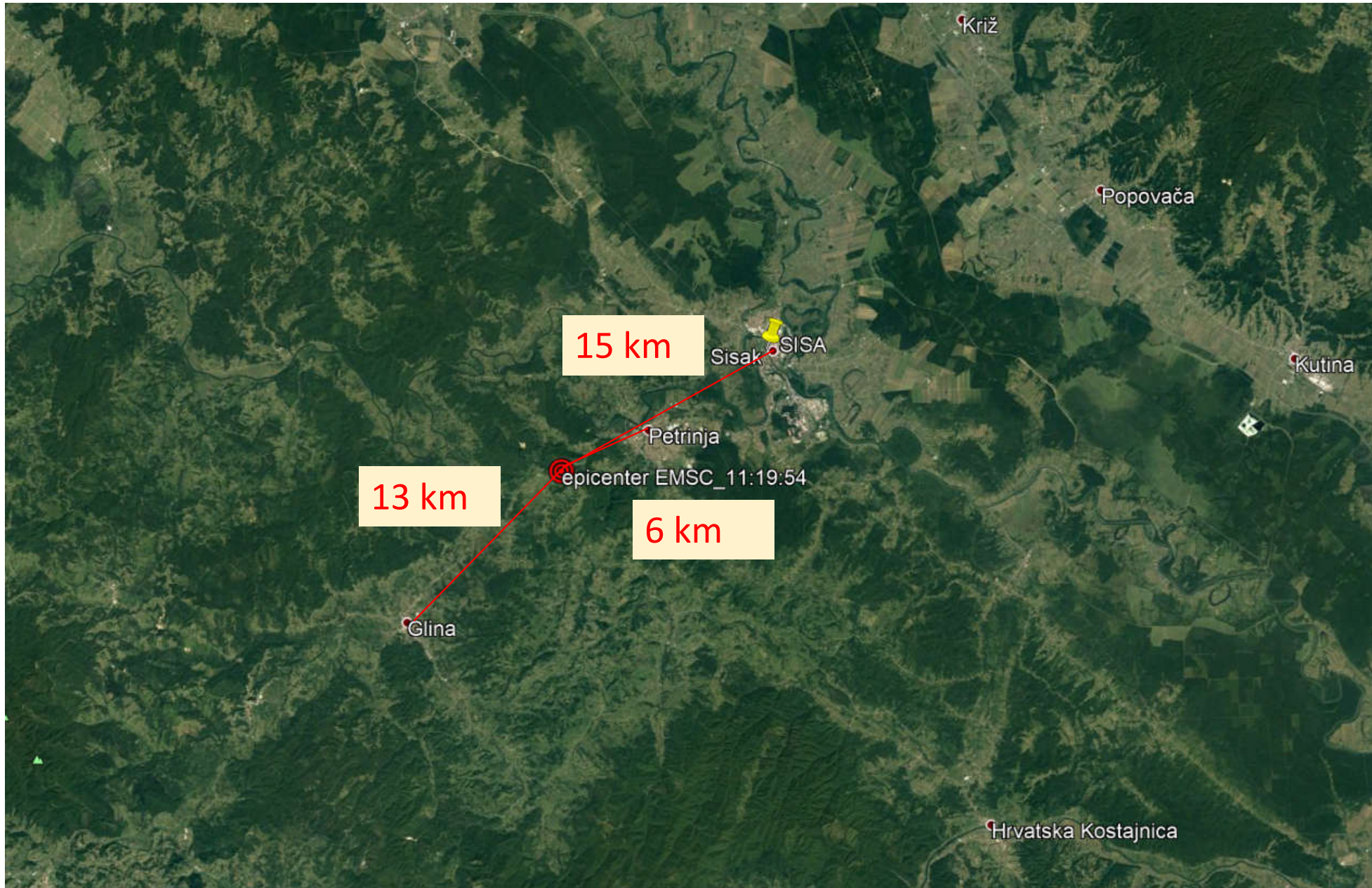
## Petrinja earthquake, 29<sup>th</sup> December 2020

Source	EMSC
Latitude	45.42°
Longitude	16.21°
Depth	10 km
Magnitude	$M_w = 6.4$
Time of origin	11:19:54.1 UTC

IGEO training 13 & 14 July 2021

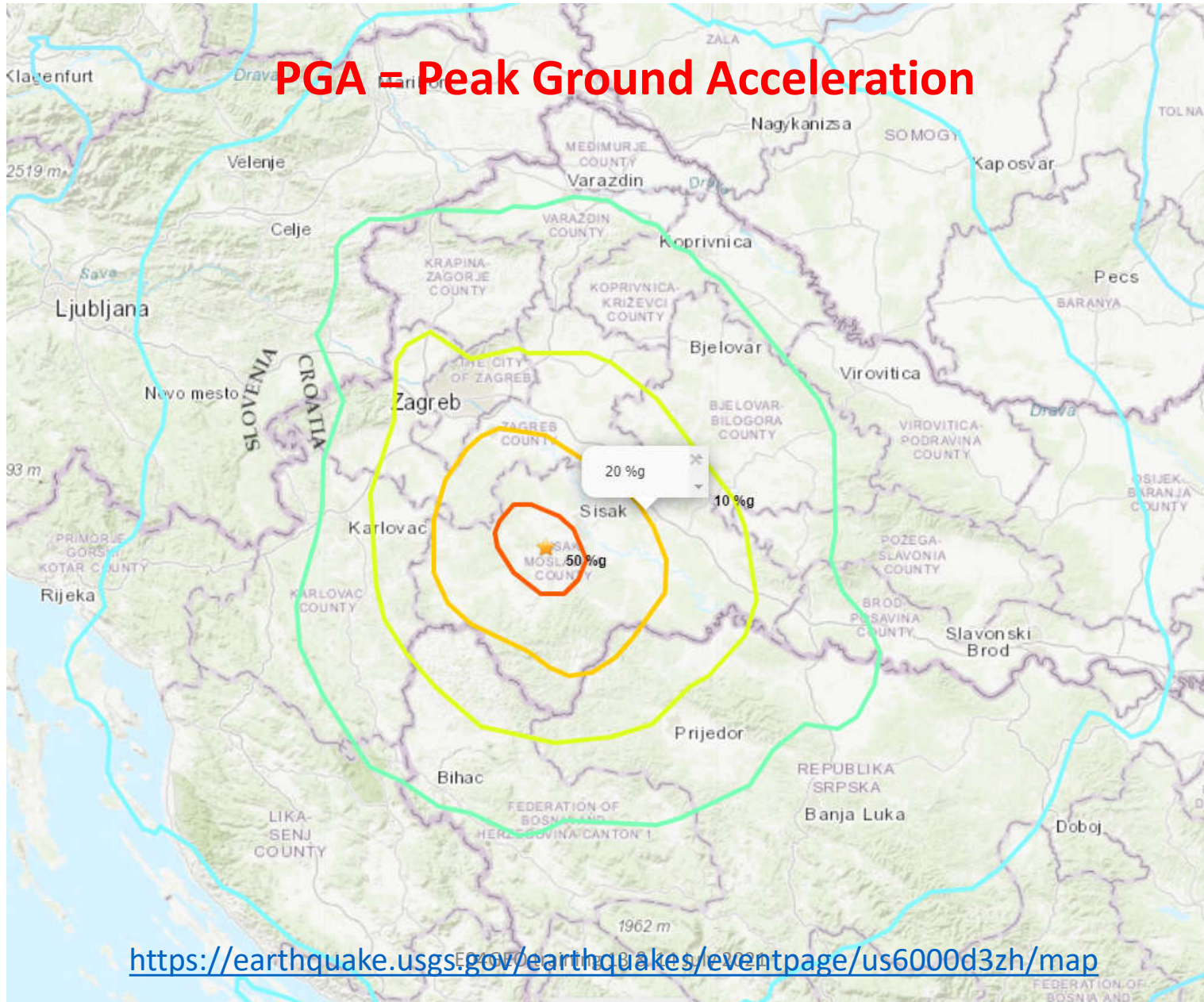
<https://www.emsc-csem.org/#2>







# PGA = Peak Ground Acceleration





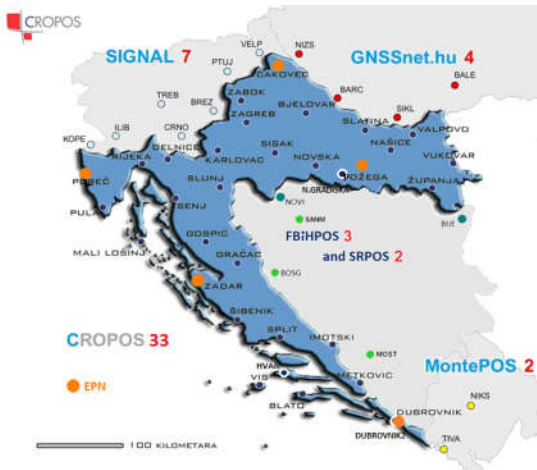
# Petrinja centre, 29<sup>th</sup> December 2020



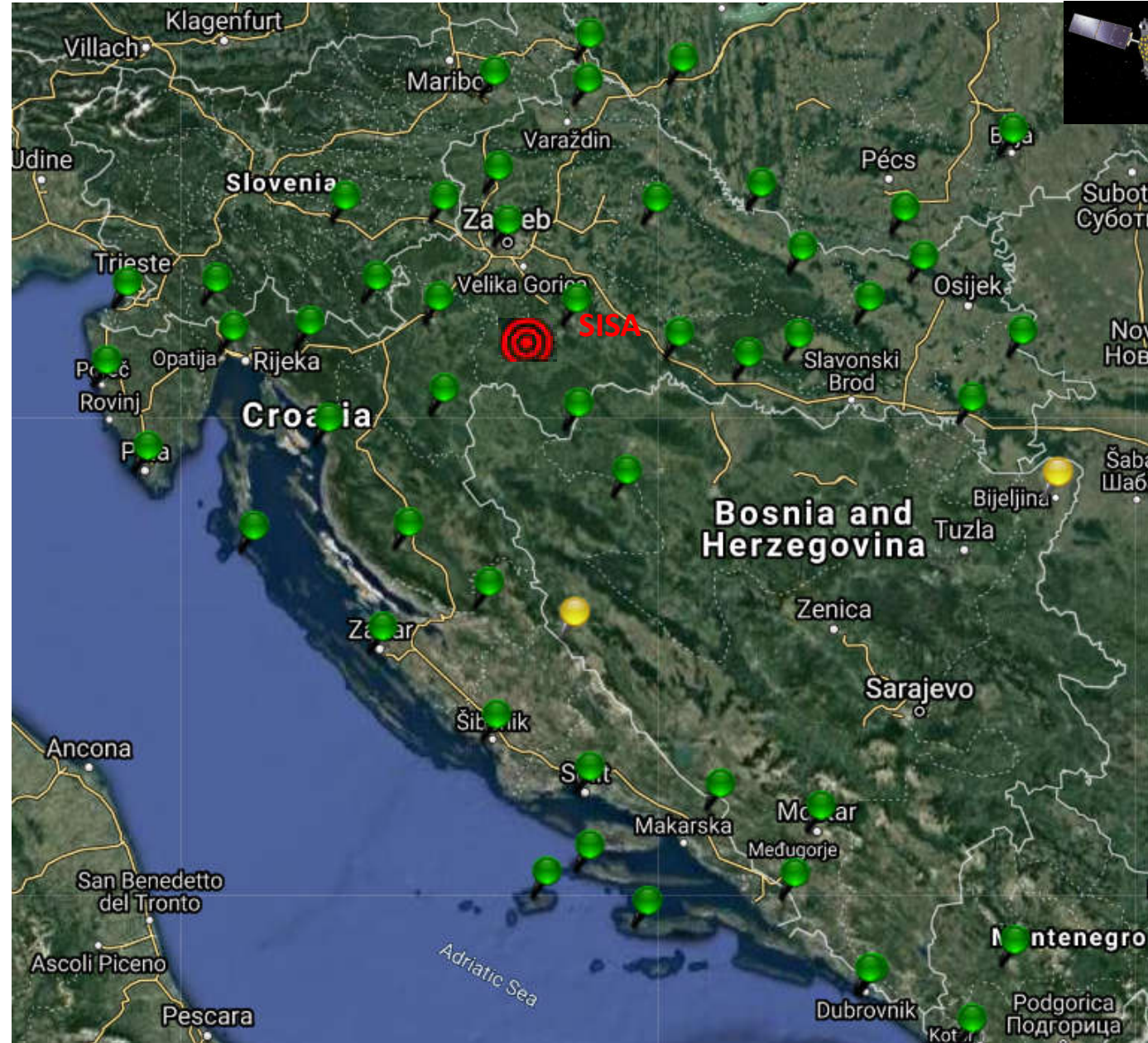


# CROPOS

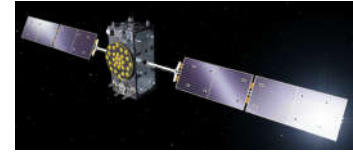
- 33 stations (HR)
- 18 stations from neighboring networks
- $\Sigma = 51$  stations



<https://www.cropos.hr/>



# CROPOS - GPPS



- SISA
- Trimble proprietary T02 format
- 15 seconds
- Timeframe (11 days):



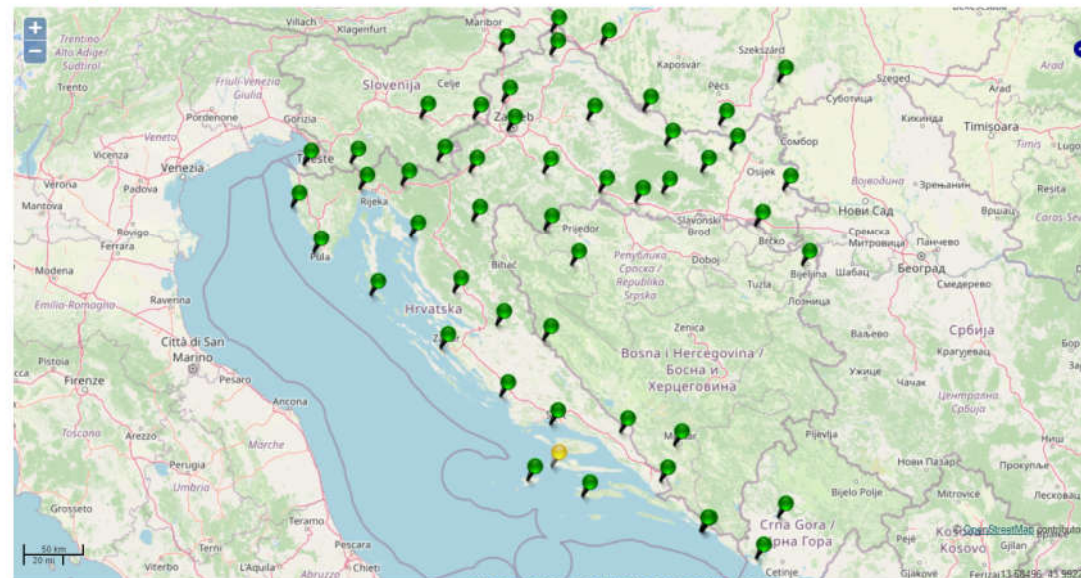
- 27.12.2020.
- 28.12.2020.
- 29.12.2020.
- 30.12.2020.
- 31.12.2020.
- 01.01.2021.
- 02.01.2021.
- 03.01.2021.
- 04.01.2021.
- 05.01.2021.
- 06.01.2021.



> Home > Sensor Map

- Home
- **Sensor Map**
- Login
- Register
- External Links
- Trimble

### Sensor Map



51 sensors:

BALE
BARC
BIJE
BJEL
BLAT
BOSG
BREZ
CAKO
CRNO
DELN
DUBR
GOSP
GRAC
HVAZ
ILIB
IMOT
KARL
KOPE
LEND
MALI
MET3
MOST
NASI
NGRD
NIKS
NIZS
NOVI
NOVS
PORE
POZE
PTUJ





# Trimble CenterPoint RTX Post-Processing

The screenshot shows the website's header with the Trimble logo and navigation links: CenterPoint RTX Post-Processing, Post-Processing, Register, Support, and Contact Us. A central banner features a world map and the text "Now Supporting Galileo" and "Process your data with GPS, GLONASS, Galileo, BeiDou, and QZSS". Below the banner, there are two columns of text. The left column welcomes users and lists features: <2cm Horizontal Accuracy, GNSS Compatibility, and No Base Station Required. The right column offers a "Register for Unlimited Access" button and a "Post-Processing" button. A disclaimer at the bottom states that the service must not be re-sold to 3rd parties without explicit permission.

<https://www.trimblertx.com/>

E04GEO training

The screenshot shows a registration and upload form. It is divided into three main sections, each highlighted with a red box:

- 1. Select a coordinate system and tectonic plate:** This section contains two dropdown menus. The first is labeled "Coordinate System:" and has "ITRF2014" selected. The second is labeled "Tectonic Plate:" and has "(Autodetect)" selected.
- 2. Select a file to upload:** This section contains a "Choose File" button and the text "No file chosen".
- 3. Provide your email address:** This section contains an "Email:" label and a text input field with the value "dsugar@geof.hr".

Below the email field, there is a checkbox labeled "I accept the terms of use listed in the Disclaimer section below." and a "Process" button. A note next to the button says "The Report will be sent to the email address provided above."

Thank you for your request. After your file, SISA3620.t02, is processed, we will send an email with the results to dsugar@geof.hr.

Thank you for your request. After your file, SISA3630.t02, is processed, we will send an email with the results to dsugar@geof.hr.

Thank you for your request. After your file, SISA3640.t02, is processed, we will send an email with the results to dsugar@geof.hr.

The order does not meet the session length requirement. The service only processes orders that are between 00:10:00 and 7.00:00:00 in session length.

Thank you for your request. After your file, SISA3660.t02, is processed, we will send an email with the results to dsugar@geof.hr.

Thank you for your request. After your file, SISA0010.t02, is processed, we will send an email with the results to dsugar@geof.hr.

Thank you for your request. After your file, SISA0020.t02, is processed, we will send an email with the results to dsugar@geof.hr.

Thank you for your request. After your file, SISA0030.t02, is processed, we will send an email with the results to dsugar@geof.hr.

Thank you for your request. After your file, SISA0040.t02, is processed, we will send an email with the results to dsugar@geof.hr.

Thank you for your request. After your file, SISA0050.t02, is processed, we will send an email with the results to dsugar@geof.hr.

Thank you for your request. After your file, SISA0060.t02, is processed, we will send an email with the results to dsugar@geof.hr.

- 27.12.2020.
- 28.12.2020.
- 29.12.2020.
- 30.12.2020.
- 31.12.2020.
- 01.01.2021.
- 02.01.2021.
- 03.01.2021.
- 04.01.2021.
- 05.01.2021.
- 06.01.2021.



# Trimble CenterPoint RTX Post-Processing



Dear Customer,

Your uploaded file (SISA3620.t02) was successfully processed.

The processing result is a report which contains coordinates in ITRF2014 (reference epoch) and ITRF08 (current epoch). For tectonic plate corrections the plate EURASIA was used. As per your request, the tectonic plate was determined automatically by the RTX-PP server based on the estimated latitude and longitude of the observation data.

The report is attached to this e-mail in XML and PDF formats.

This e-mail was generated automatically by [TrimbleRTX.com](http://TrimbleRTX.com).

Powered by



## Post-Processing Service Based on RTX Technology

TrimbleRTX.com

Contributor: dsugar@geof.hr  
 Reference Name: SISA3620.t02  
 Upload Date: 07/13/2021 14:15:24 UTC

Report Time Frame:  
 Start Time: 12/27/2020 00:00:00 UTC  
 End Time: 12/27/2020 23:59:45 UTC  
 Observation File Type(s): T02  
 Observation File(s): SISA3620.t02  
 Antenna:  
 Name: TRM115000.00 TZGD  
 Height: 0.000 m  
 Reference: Bottom of antenna mount  
 Receiver Name: TRIMBLE ALLOY  
 Coordinate Systems: ITRF2014  
 Tectonic Plate: Eurasia (Auto-detected)  
 Tectonic Plate Model: MORVEL56  
 Processing Interval: 15 s

### Statistics

# Total Obs	# Usable Obs	# Used Obs	Percent
5760	5760	5760	100

### Used Satellites

# Total Satellites:	80
GPS:	G01 G02 G03 G04 G05 G06 G07 G08 G09 G10 G12 G13 G15 G16 G17 G18 G19 G20 G21 G22 G23 G24 G25 G26 G27 G28 G29 G30 G31 G32
GLONASS:	R01 R02 R03 R04 R05 R07 R08 R09 R12 R13 R14 R15 R16 R17 R18 R19 R20 R21 R22 R24
Gallileo:	E01 E02 E03 E04 E05 E07 E08 E09 E11 E12 E13 E15 E19 E21 E24 E25 E26 E27 E30 E31 E33 E36
BeiDou:	C06 C07 C09 C10 C11 C12 C13 C14

### Processing Results

ITRF2014 at Epoch 2010.0		
Coordinate	Value	$\sigma$
X	4297851.915 m	0.003 m
Y	1262317.958 m	0.003 m
Z	4525446.017 m	0.003 m
Latitude	45° 29' 7.48603" N	0.002 m
Longitude	16° 22' 4.76558" E	0.002 m
El. Height	158.894 m	0.004 m

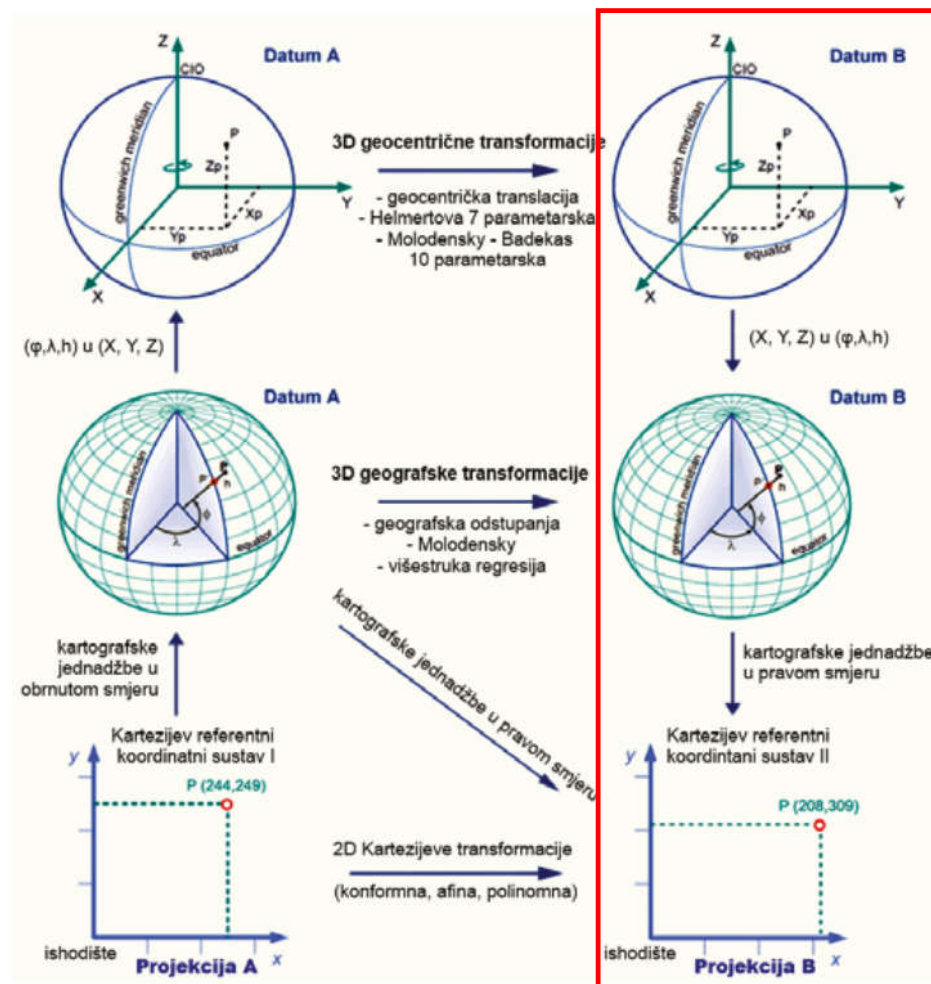
ITRF2014 at Epoch 2020.99		
Coordinate	Value	$\sigma$
X	4297851.752 m	0.003 m
Y	1262318.133 m	0.003 m
Z	4525446.123 m	0.003 m
Latitude	45° 29' 7.49090" N	0.002 m
Longitude	16° 22' 4.77541" E	0.002 m
El. Height	158.895 m	0.004 m

### Report Information

Trimble RTX Solution ID: 25540745  
 Solution Type: Static  
 Software Version: 8.5.0.19198  
 Creation Date: 07/13/2021 14:17:40 UTC

# Trimble CenterPoint RTX Post-Processing

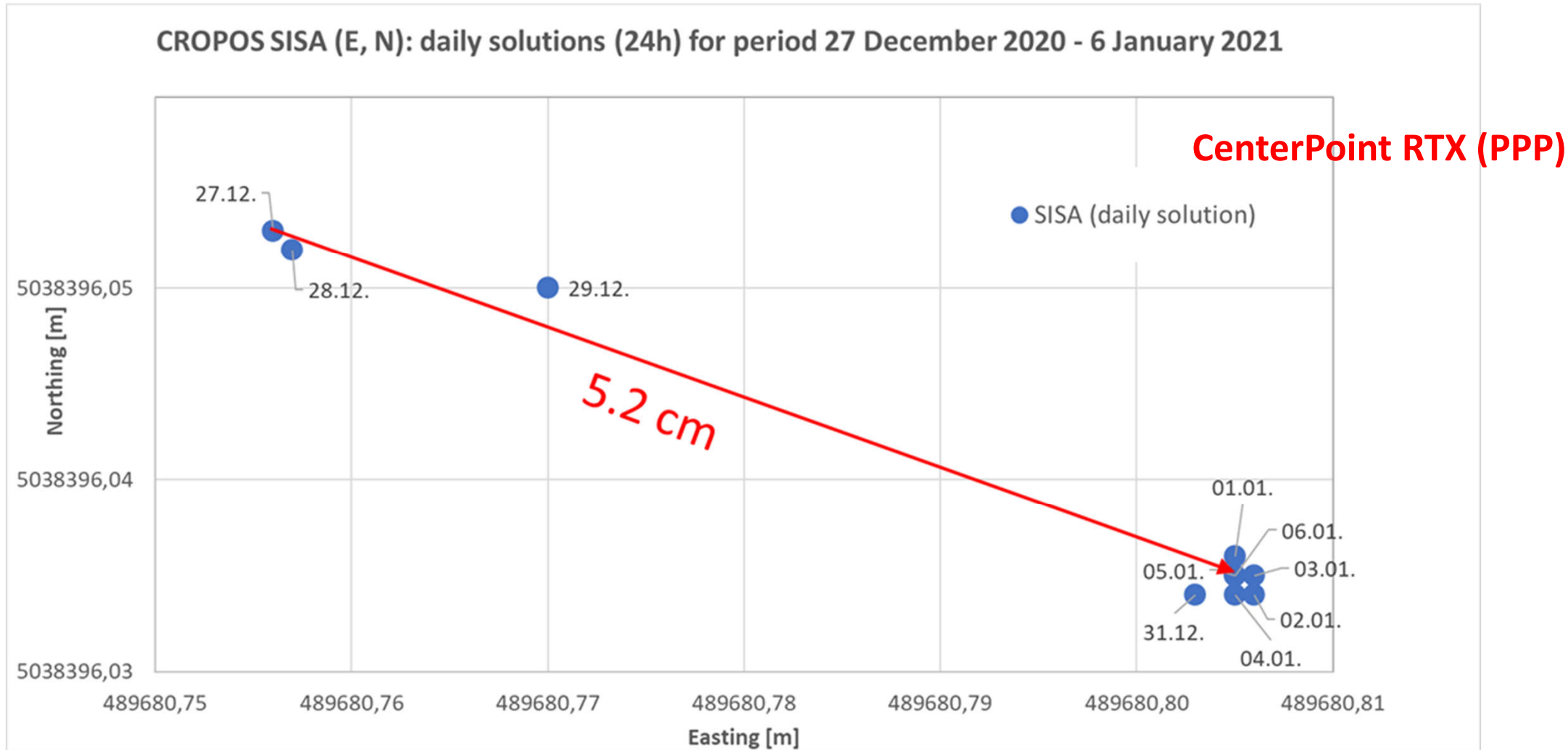
- Transformation:  $(X, Y, Z)$  ITRF 2014,  $e = 2010.0 \rightarrow (E, N, h)$  GRS80



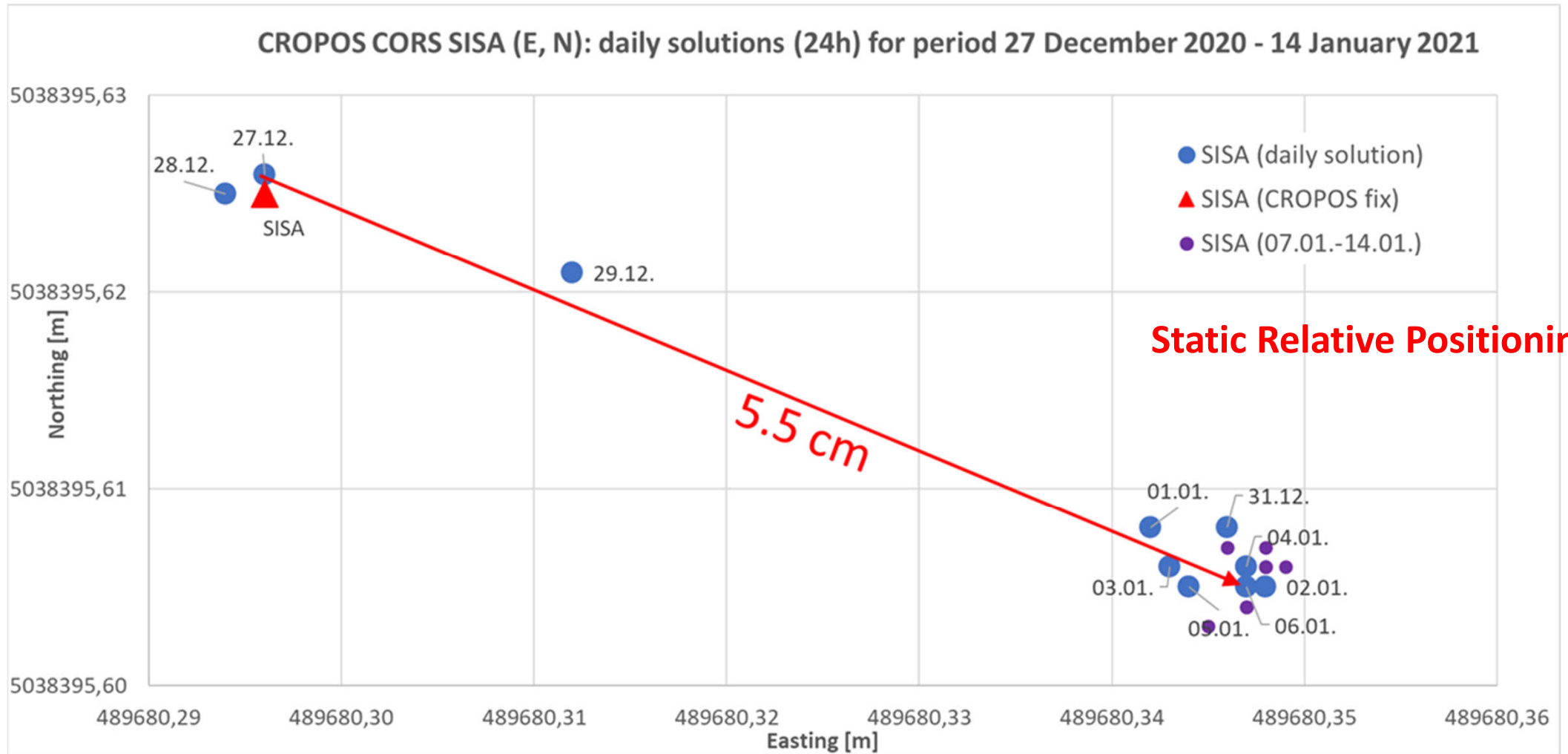
Herent, M., Horvat, H., Kriste, I. (2013):  
 Transformacija koordinata homogenih polja u  
 HDKS, Ekscentar br. 16, pp.42-45



# SISA – horizontal displacement (27.12. – 06.01.2021).

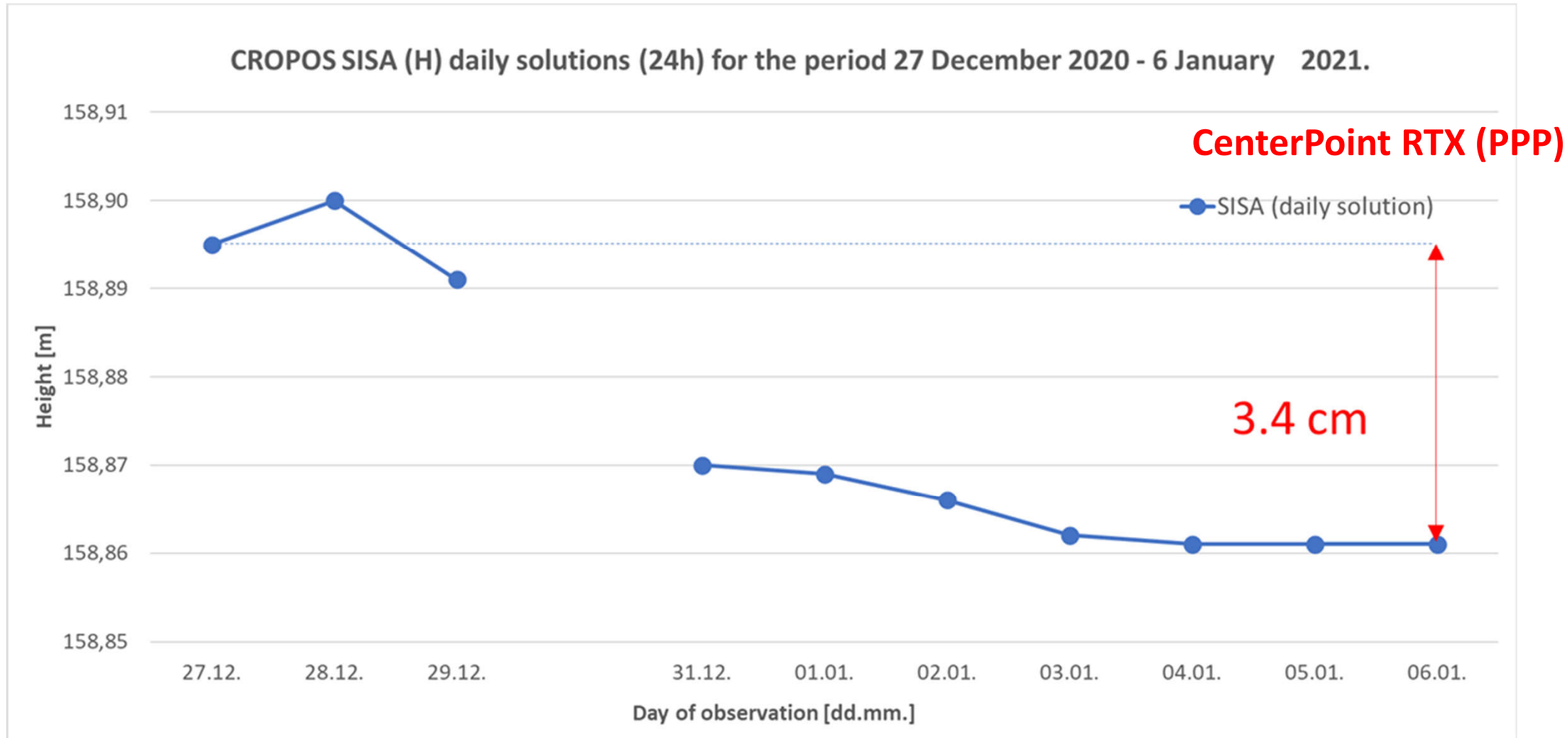


# SISA – horizontal displacement (27.12. – 06.01.2021.)

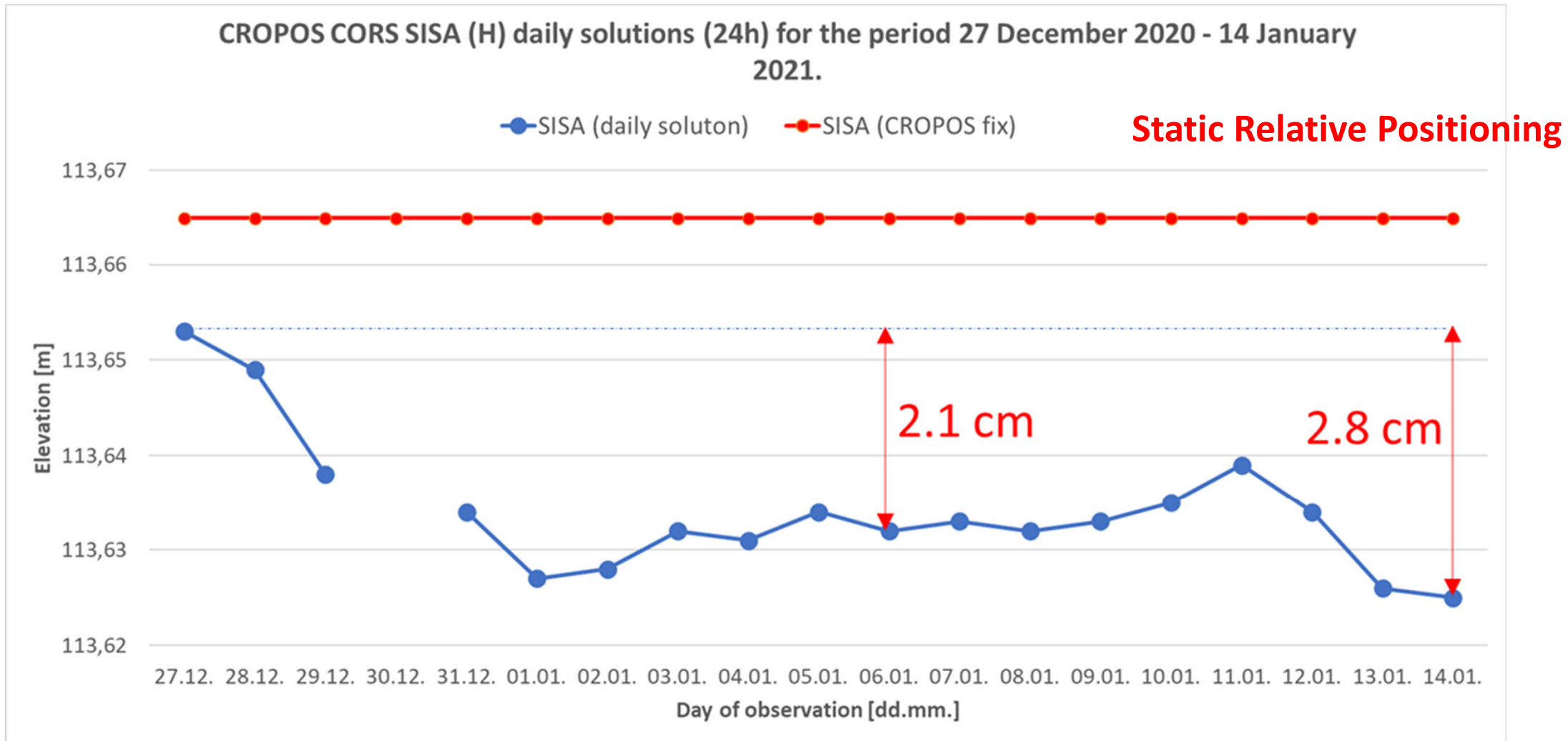




# SISA – vertical displacement (27.12. – 06.01.2021.)

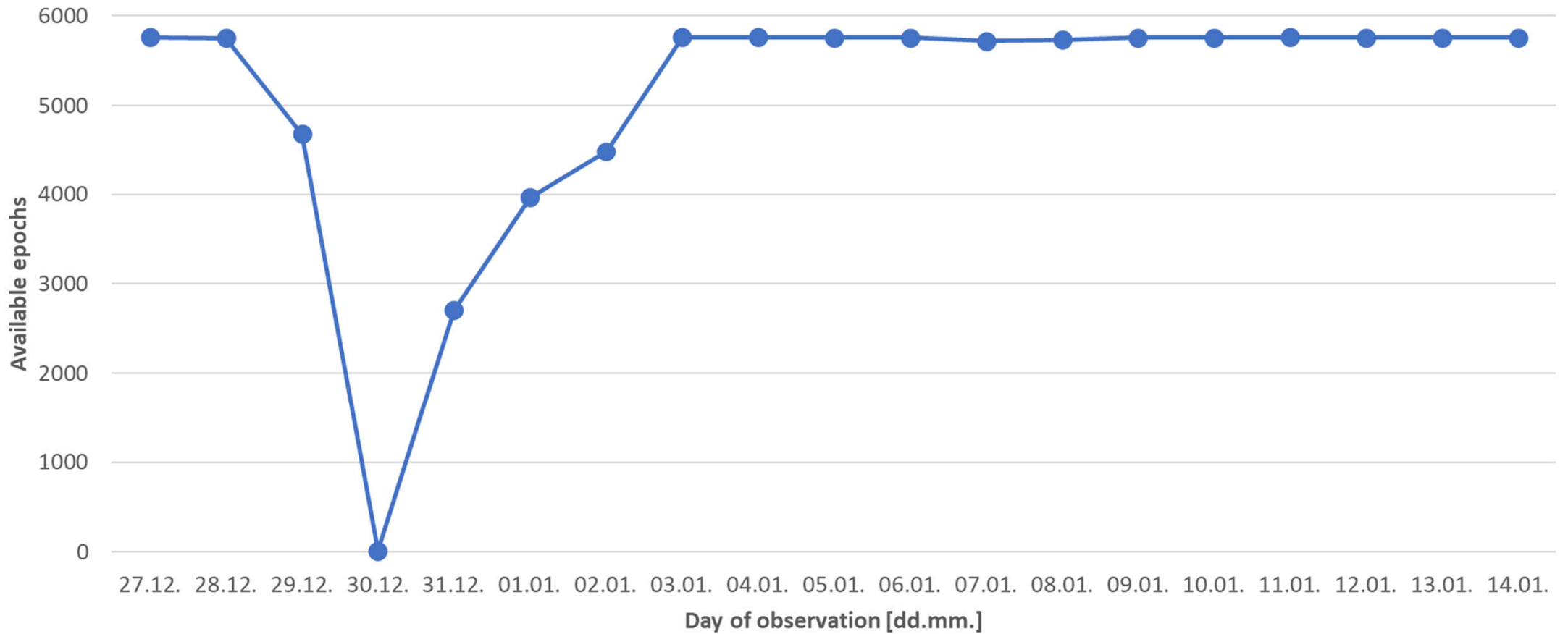


# SISA – vertical displacement (27.12. – 06.01.2021.)



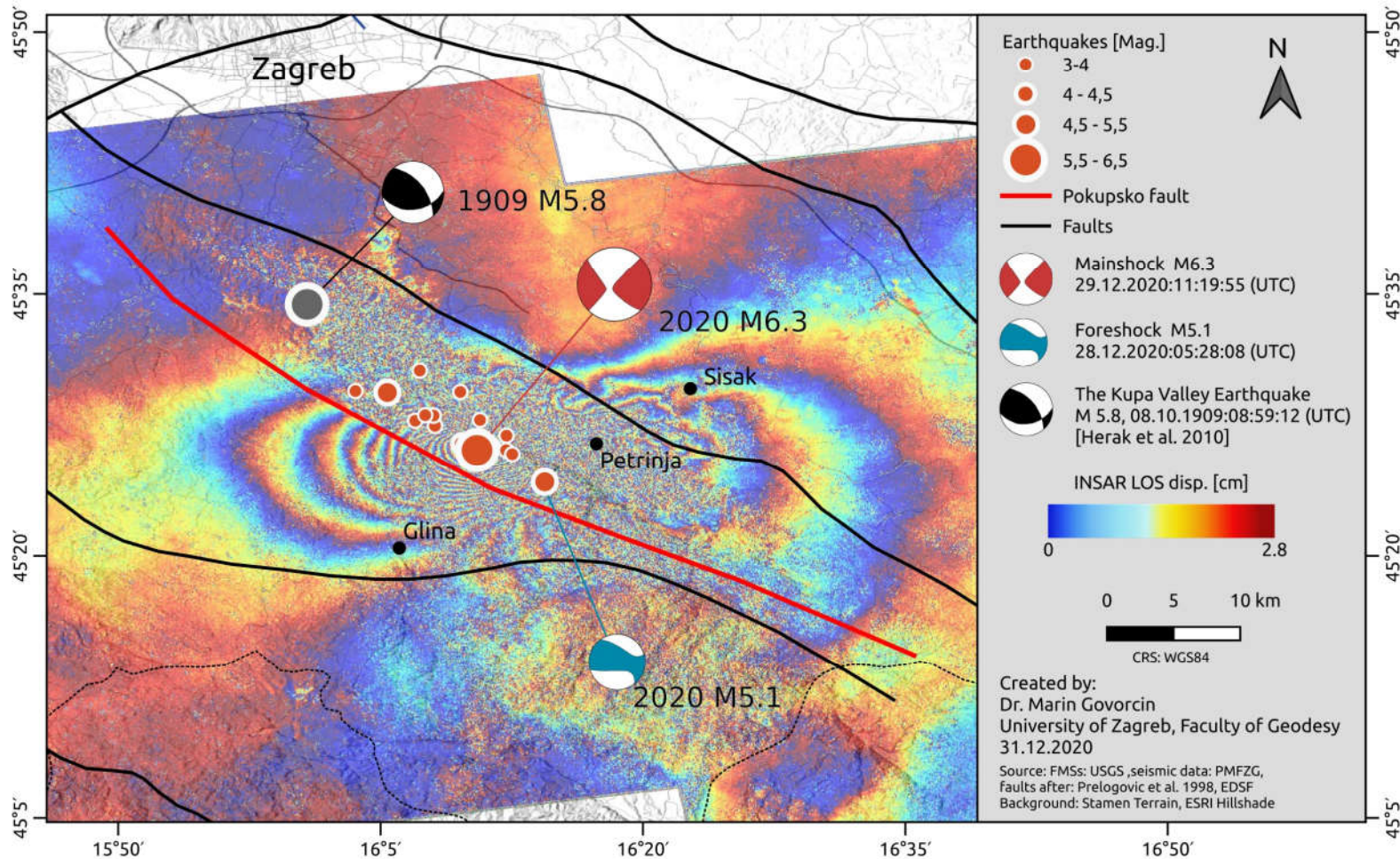


Available daily epochs at CORS SISA for the period  
27 December 2020 - 14 January 2021



# Petrinja epicentral area: 12/2020 (M6.3)

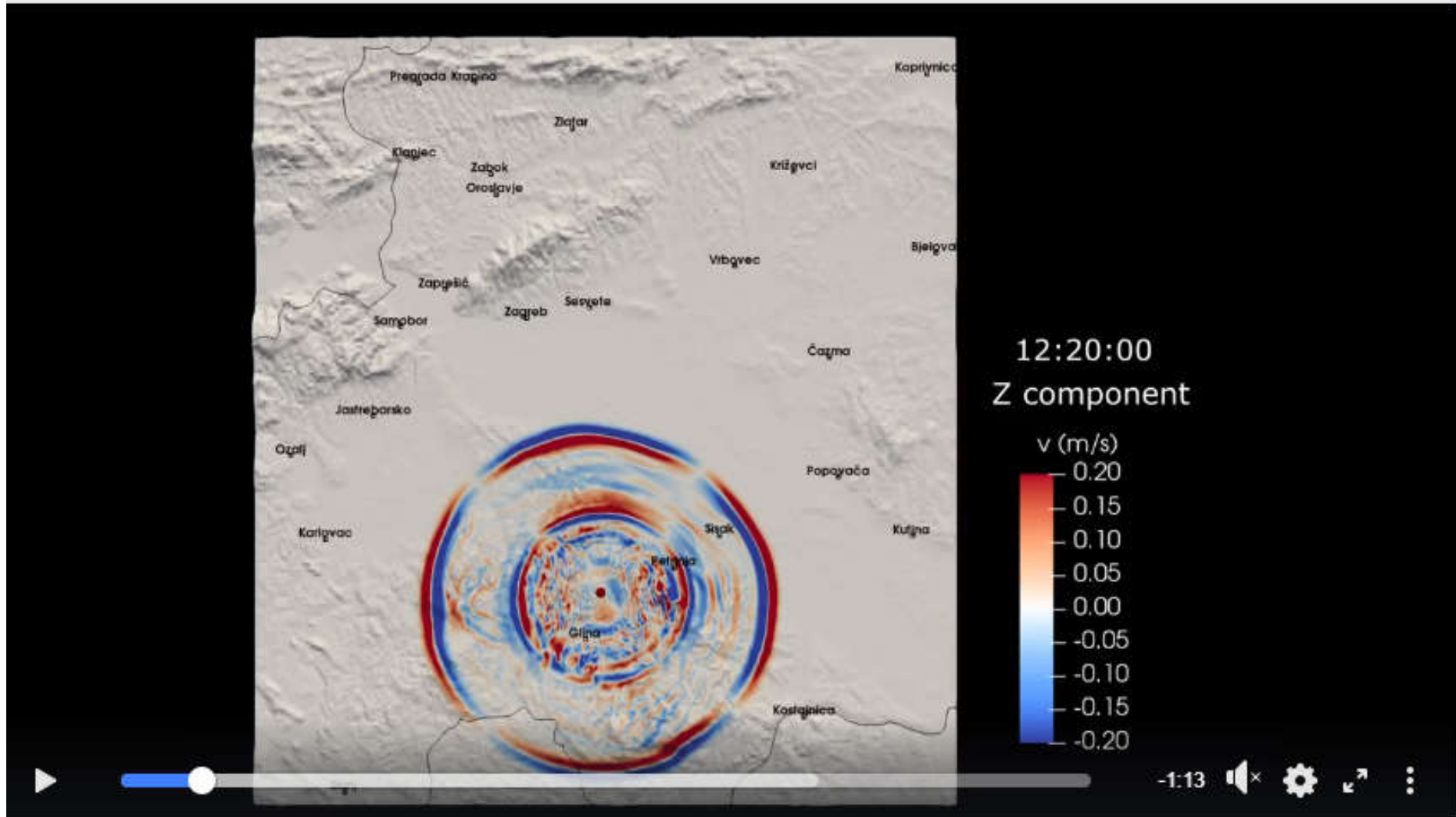
Dec 29, 2020 M6.3 Petrinja earthquake (NW Croatia)  
Sentinel-1 (T146) M: 24.12.2020 S: 30.12.2020 T:16:50



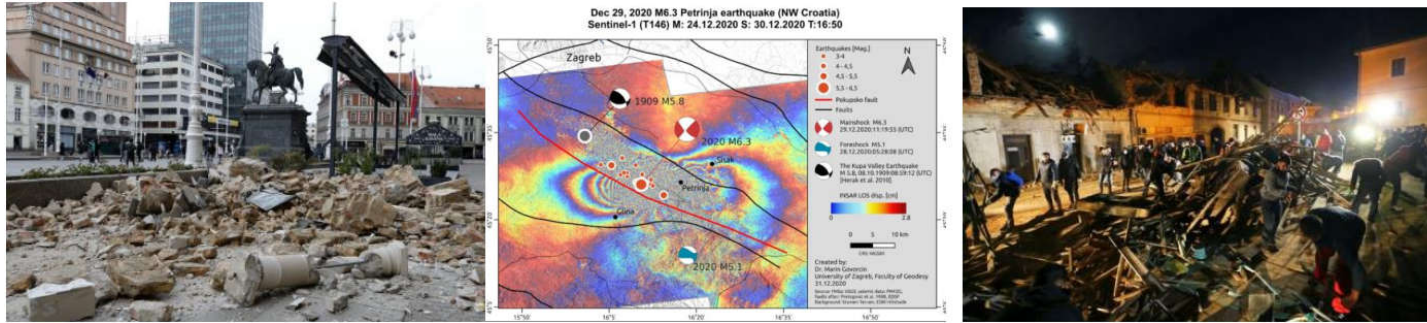
<https://twitter.com/Govorcin/status/1344422722403753984/photo/1>



# Petrinja epicentral area: 12/2020 (M6.3)



<https://www.facebook.com/geofizika.uzivo/videos/potres-kod-petrinje-simulacija-potresne-tre%C5%A1nje/164199575240912/>



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**E04GEO training: Fast disaster response –  
satellite technologies for surface displacement monitoring**  
**Displacement of CROPOS SISA station in the period 27 December 2021  
– 6 January 2021 assessed by GNSS PPP method**



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