



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

EO4GEO webinar

Fast disaster response - satellite technologies for surface displacement monitoring

Quality
Risks
Conclusion



Content

- Quality assurance in computation and interpretation process and information dissemination activities
- Surface displacement consequences and necessary actions
- Risks
- Conclusion

Quality assurance

- Providing support to rescue and recovery activities and scientific information about the event geo-professionals can find themselves in two situations:
 - to be facilitator of information exchange – without responsibility for the content the information
 - to be creator of information – with full responsibility for the content of the information

Quality assurance

- The need to present to the public as soon as possible the information resulting from a catastrophic earthquake is at odds with the need to carry out the processing of EO and GNSS data taking into account all factors and with controls that will guarantee the correctness of the results!

Facilitator of information exchange

- Application developer and administrator:

No

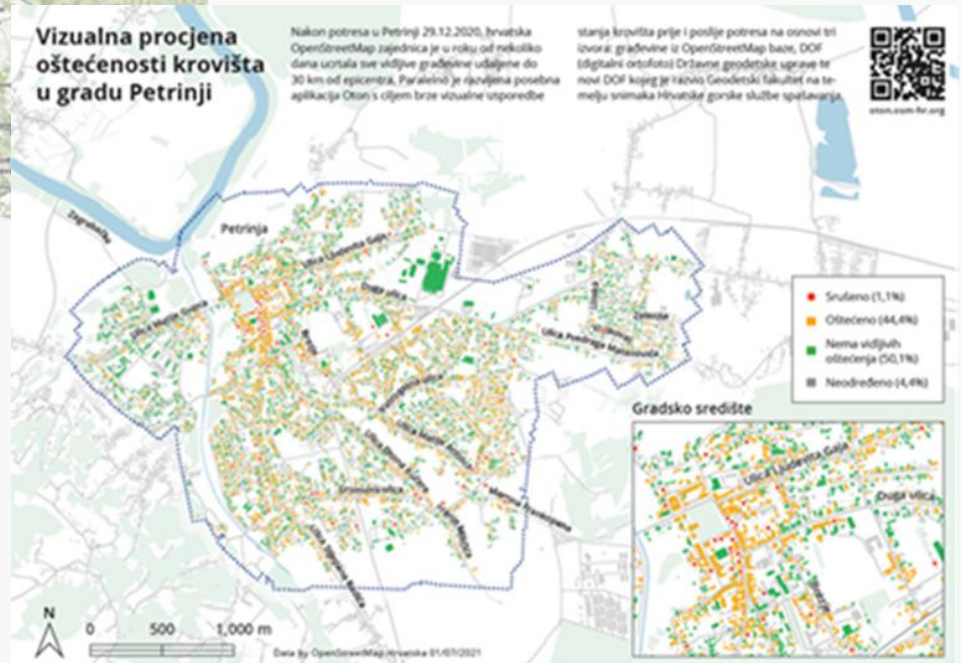
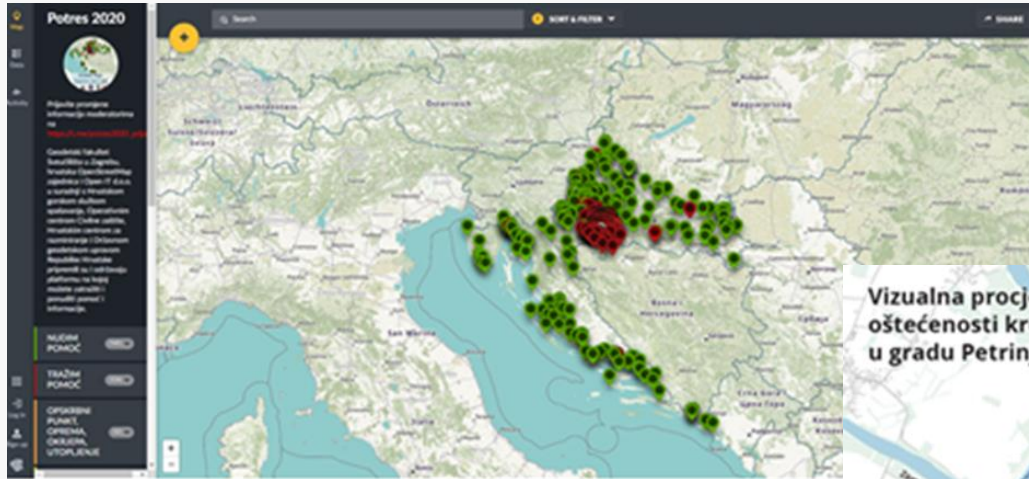
- Responsibility -

Yes

Information content

How the apps work
Administering
application

Facilitator of information exchange



Emphasis on:

- Functionality
- Simplicity
- Graphical quality

Creator and publisher of information

- Author of information:

No

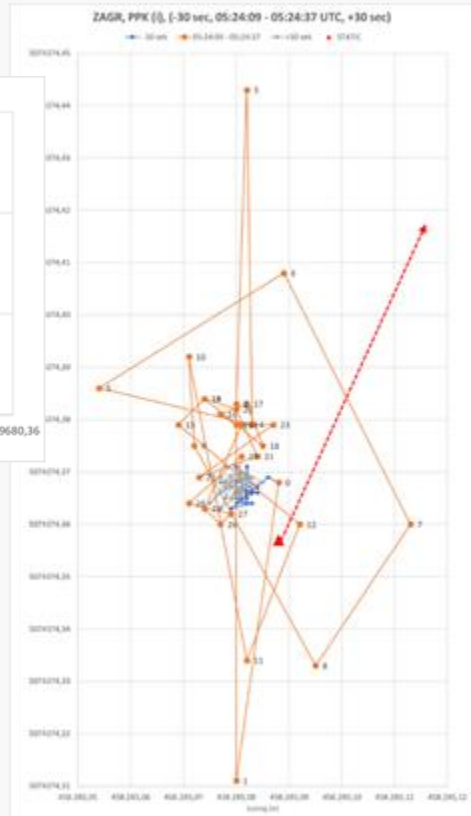
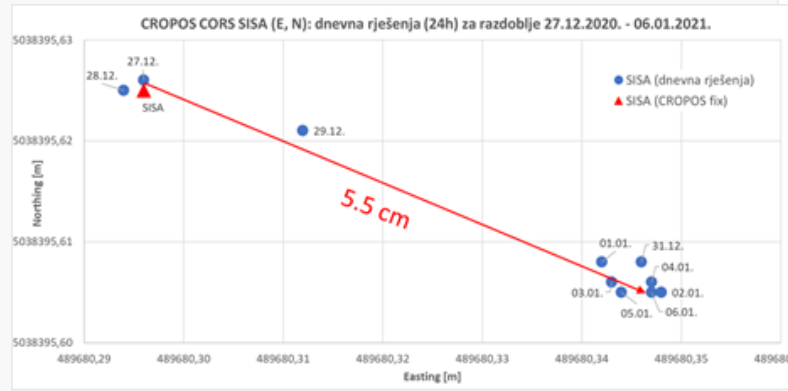
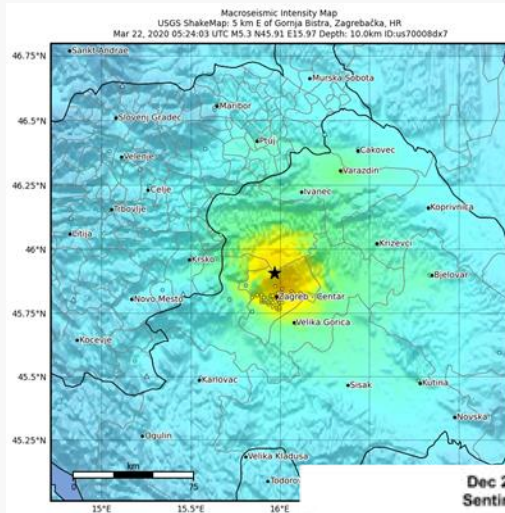
- Responsibility -

Yes

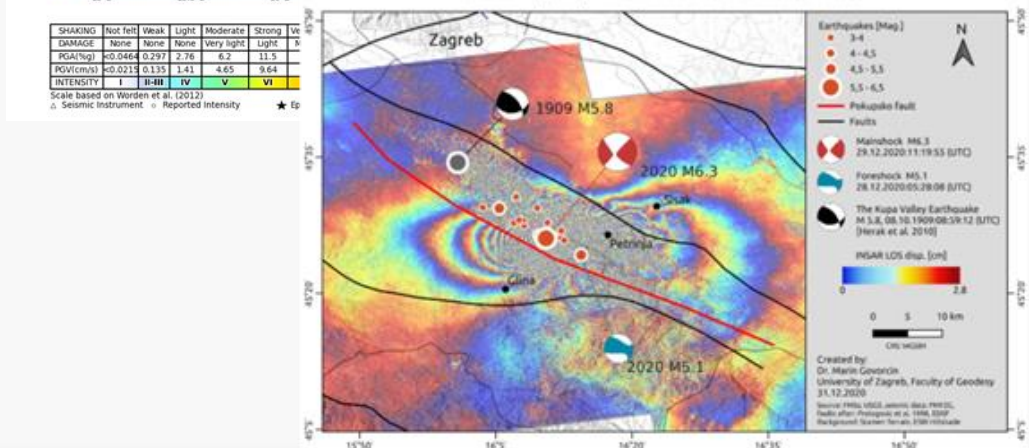
How the information will
be used (?)

Content of information
Presentation of
information

Creator and publisher of information



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





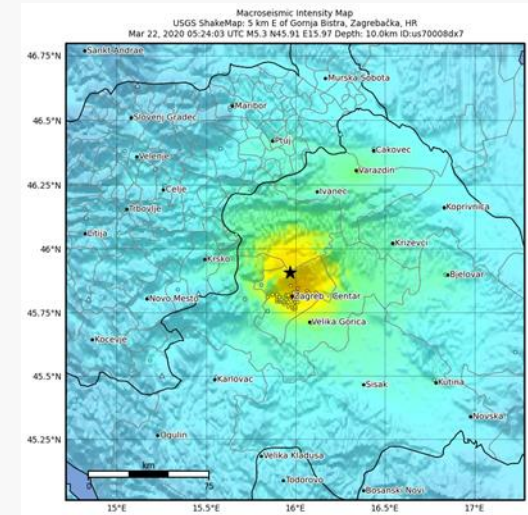
Creator and publisher of information

Emphasis on:

- Reliability of computed and published results (information)
- Conclusions drawn from computed results
- Way how information has been communicated with public
- Transparency of used computational procedures

Examples

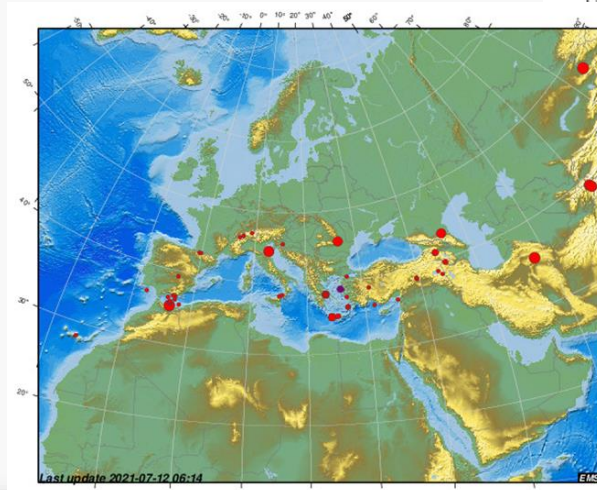
- Standardized service
- Highly automatized
- First (fast) and final result differ insignificantly (usually 0,1 on Richter scale)



SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	None	None	None	Very light	Light	Moderate	Moderate/heavy	Heavy	Very heavy
NO	0.0464	0.2977	2.76	6.2	11.3	21.5	40.1	78.7	>139
0.0215	0.135	1.41	4.65	9.64	20	41.4	85.8	>178	
I	II-III	IV	V	VI	VII	VIII	IX	X	XI

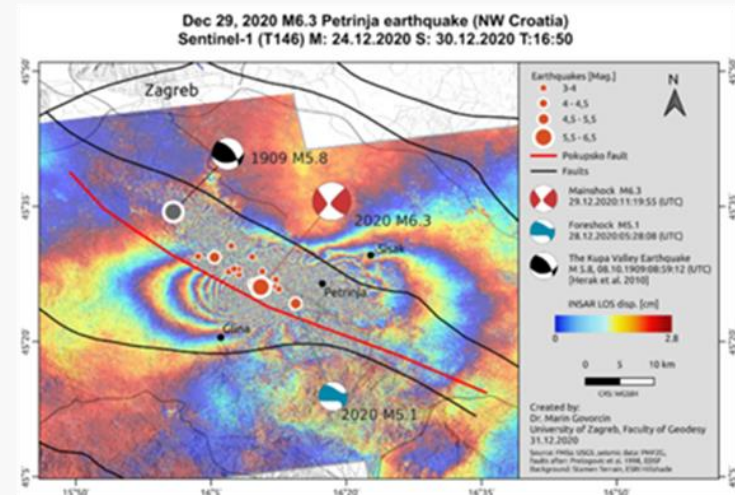
on Worden et al. (2012) Version 8: Processed 2020-04-02T11:58:27Z
Instrument ○ Reported intensity ★ Epicenter

- **Fast and reliable!**



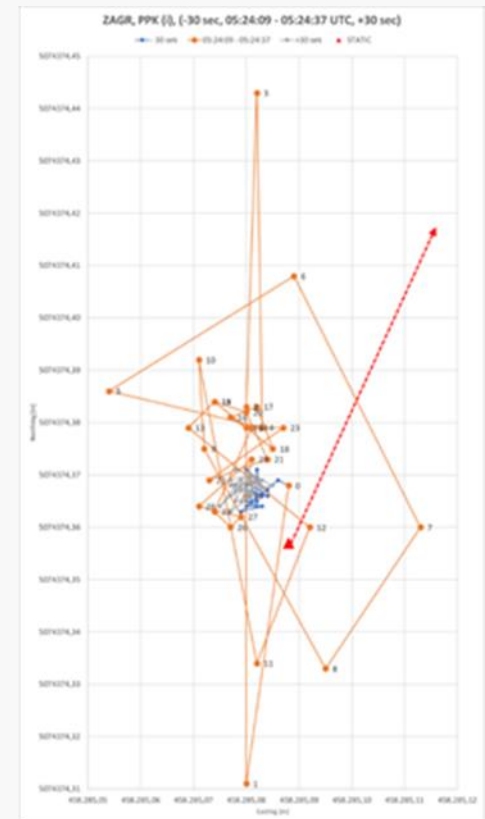
Example

- InSAR - first (fast) result may not take in consideration all necessary factors (like atmospheric corrections, etc.)
- In Petrinja earthquake several independent computations have been made and results differ somewhat
- **Scientific caution necessary in interpretation of results**



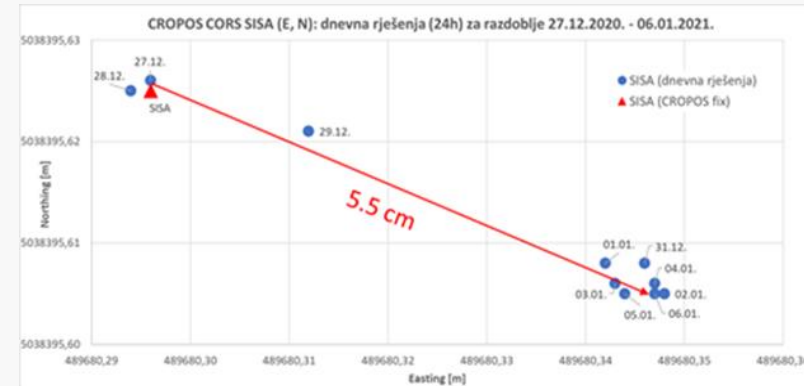
Example

- First (fast) results may not take in account that neighbouring CORS stations might also be affected by kinematic surface displacement during the earthquake
- Depending on CORS station antenna stabilization kinematic displacement may result from surface displacement and building shaking
- **Scientific caution necessary**



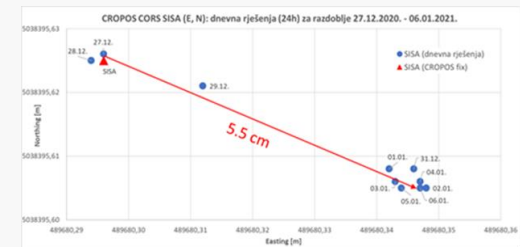
Example

- Computation must follow prescribed procedures
- First (fast) results may not take in account that neighbouring CORS stations might also be affected by surface displacement caused by earthquake
- Regarding GNSS we must be aware measurement noise level
- **Scientific caution necessary**



Surface displacement consequences and necessary actions

- Present national reference frames rely on GNSS measurements, standard wise on permanent GNSS networks
- GNSS coordinates of CORS stations are global and absolute
- Surface displacement caused by earthquake causes change of CORS stations positions (coordinates)
- Affected stations may not be used in this case until their coordinates are not recomputed

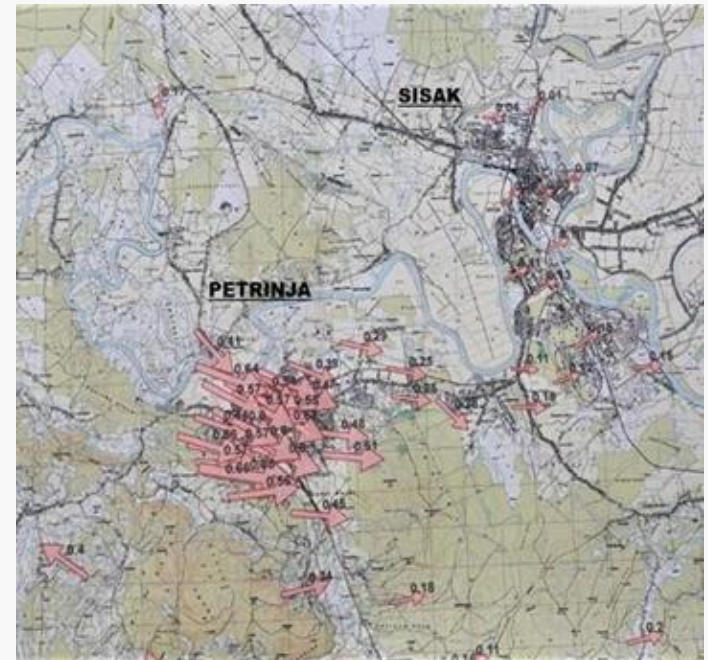


Surface displacement consequences and necessary actions

- Surface displacement caused by earthquake result in change of coordinates of all stabilized geodetic points in affected area
- Because of the surveying technologies we use today the points of geodetic network must have correct coordinates – remeasurement of points of geodetic network, in case of detected surface displacements, is necessary!

Example

- Checking the condition of geodetic network is possible by fast remeasurement of geodetic network points.
- It is not irrelevant how such remeasurement is done
- Reliability of results directly depend on how measurements have been conducted
- **Scientific caution and transparency necessary!**



Publishing the results (information)

- Media incline to bombastic news
- It is responsibility of scientist and professionals that information is presented in proper way
- We should be very cautious in our statements (even knowing that after 3 days news is forgotten)

Risks

- Unreliable – incorrect information may
 - mislead rescue and recovery services
 - cost time which is always lacking in rescue and recovery activities
 - create confusion
 - cause unnecessary costs to society
 - cause loss of credibility for specific profession, institution, company, scientists, professionals

Conclusion (1)

- Satellite technologies like InSAR and GNSS are mighty tools which, in case of catastrophic earthquakes, can provide valuable information to rescue and recovery services and general public.
- They can provide reliable information about surface displacement in cases of catastrophic earthquakes.

Conclusion (2)

- In case of catastrophic earthquake (rough estimation of magnitude above 5,0 on Richter scale) fast check if there's been a surface displacement should become standard activity of network administrator and scientists.
- This is especially important if some CORS station is near the epicenter. Detected surface displacement on CORS station should result with its temporary exclusion from the network.

Conclusion (3)

- Regardless to the technology computations and measurements must be conducted in accordance to prescribed procedures – this is the only safe way to achieve reliable results!
- When presenting (publishing) results / information – author(s) must detain scientific caution.

EO4GEO project training program

- This and other EO4GEO trainings result from existing concepts described in EO4GEO **Body of Knowledge (BoK)** and **training materials** will be available on the project webpage (under **Resources**).
- Continues and you can find announcements of next trainings on EO4GEO webpage
- If you are interested in EO4GEO activities, there are several opportunities to join – see project webpage



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

Fast disaster response - satellite technologies for surface displacement monitoring

Quality
Risks
Conclusion

Željko Bačić, zbacic@geof.hr



www.eo4geo.eu



@EO4GEOtalks