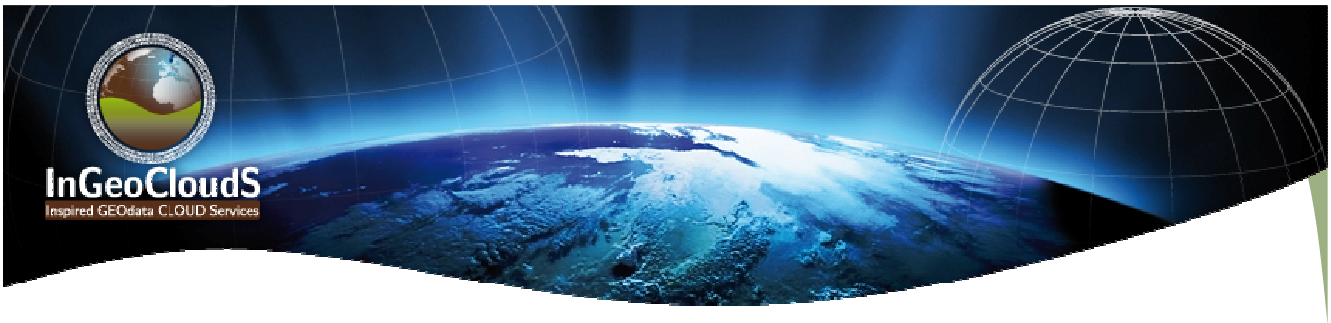


Shake Maps Service for Greek Region

EPPO – Greece

Konstantinidou Kiriaki (IT)

Savvaidis Alexandros (Dr. Geophysicist)

Presentation Outline

1. Shake Maps – What are they?

2. Shake Maps Service Implementations

3. EPPO Shake Maps Service

4. Conclusion

Shake Maps – What are they?

- Representation of ground shaking due to earthquakes
- Information complementary to epicenter, magnitude
- Ground shaking levels depend on distance from source, rock & soil conditions, structure of Earth's crust
- Grid of values

Who needs them? Diverse Audience:

- Scientists (seismologists, civil engineers)
- Emergency Response Agencies
- Commercial Parties (construction companies)
- Media and the public

Shake Maps - What are they?

Potential Uses:

- Post-earthquake response
- Potential damage estimation
- Spatial network analysis of emergency response

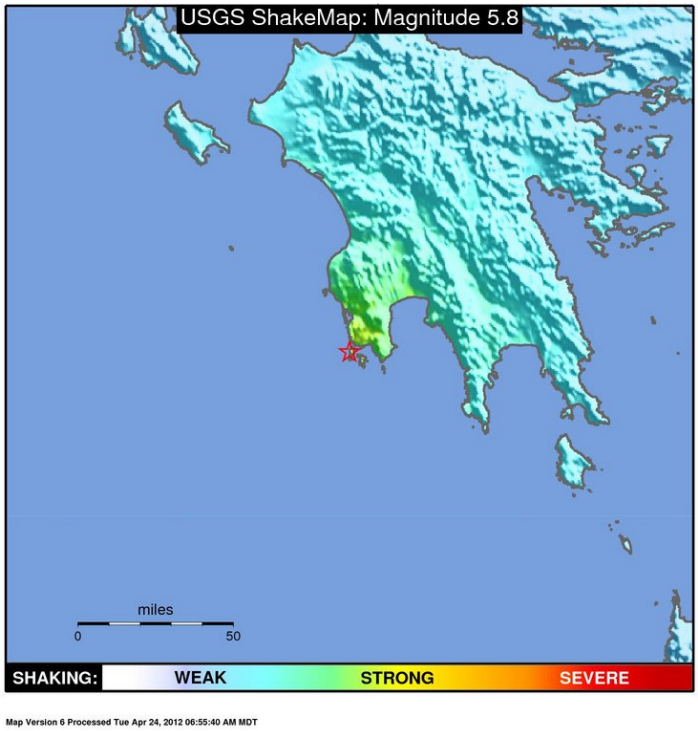
Map content:

- Peak ground acceleration, velocity and spectral response maps,
- Instrumental Intensity map (expected felt and damage distribution)

Map formats:

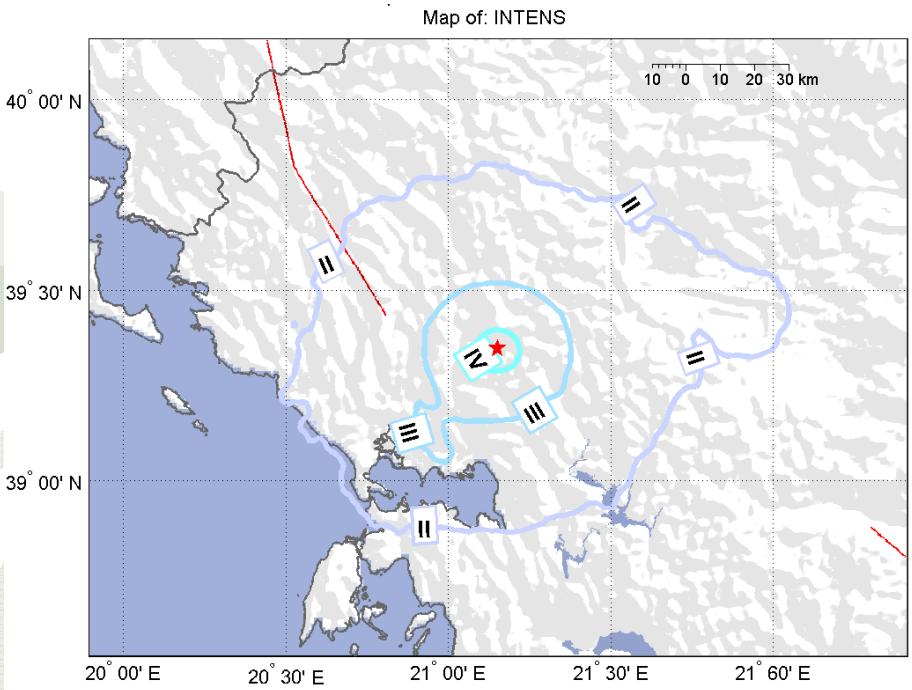
- Grid data
- Images
- GIS files (Shape files, KML, …)

Shake Maps – An example



Picture Taken From USGS Archive

Shake Maps – An example



Picture Taken From KOERI Archive

Shake Maps – An example

Picture Taken From USGS Archive

Shake Maps – Calculation

- Real acceleration or velocity data from seismological networks
- Where networks are not very dense interpolation takes place
- Ground motion prediction equations (different for each area) are used to estimate values in areas with gaps

Calculation can take place in almost real-time if all the necessary data is available a few minutes after the earthquake.

Shake Maps – Publication

- Automatic or manual generation.
- Availability through web, ftp or other electronic means
- A preliminary map is available a few minutes after the earthquake (if real-time data is available)
- The initial data is raw and not manually checked
- The map is updated as soon as humanly checked data becomes available
- The map is an approximation and more reliable in the large scale

Presentation Outline

1. Shake Maps – What are they?
2. **Shake Maps Service Implementations**
3. EPPO Shake Maps Service
4. Conclusion

Shake Maps – Implementations

As Seismological Networks become more advanced:

- more dense, reliable, accurate and
- with Internet connectivity

almost real-time Shake Map Services are possible to realize and are getting increasingly popular

Shake Maps – Implementations

Well known Shake Map Service implementations

- The Japanese implementation
- The U.S. Geological Survey Shake Maps Service
- The SAFER Project implementations
- The NERIES Project – JRA3 Initiative implementation
- The EMSC implementation

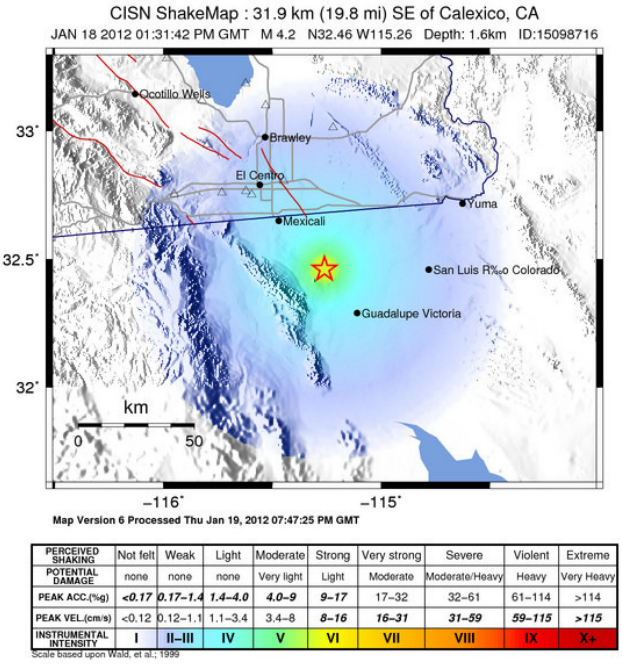
Shake Maps – Implementations

http://earthquake.usgs.gov/earthquakes/shakemap

U.S.Geological Survey (USGS) - USA

Automatic near-real time production of Shake Maps in big seismo events.

Software **ShakeMap** distributed as open source.



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.17	0.17–1.4	1.4–4.0	4.0–9	9–17	17–32	32–61	61–114	>114
PEAK VEL.(cm/s)	<0.12	0.12–1.1	1.1–3.4	3.4–8	8–16	16–31	31–59	59–115	>115
INSTRUMENTAL INTENSITY	I	II–III	IV	V	VI	VII	VIII	IX	X+

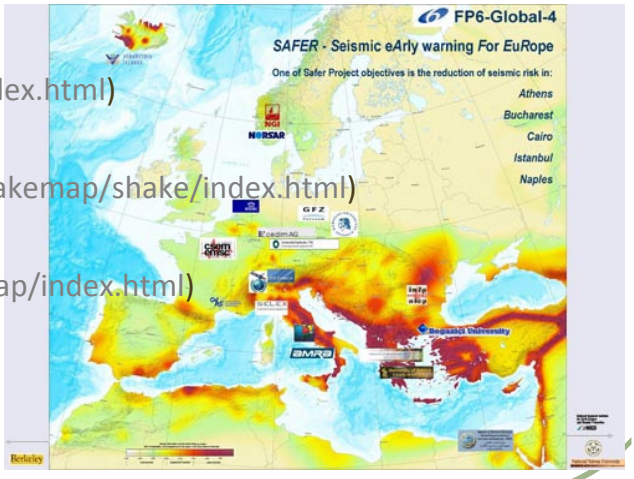
Scale based upon Wald, et al.; 1999

Shake Maps – Implementations

SAFER (Seismic eArly warning For EuRope) FP6 E.C. project adopted the *ShakeMap* software developed by the U.S.G.S.

- INGV – Italy (http://shakemap.rm.ingv.it/shake/index.html)
- ETHZ – Switzerland (http://www.seismo.ethz.ch/static/shakemap/shake/index.html)
- NIEP - Romania (http://scomp.infp.ro/~shake/shakemap/index.html)

http://www.saferproject.net



Shake Maps – Implementations

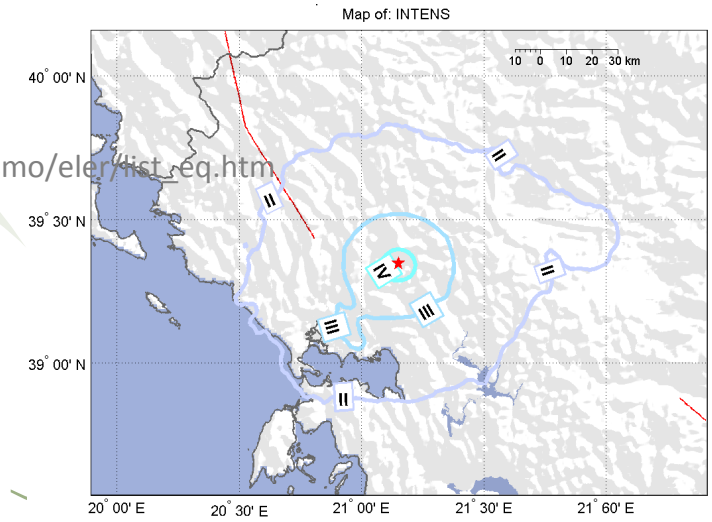
NERIES (Network of Research Infrastructures for European Seismology) FP6 E.C. Project – Joint Research Activity 3

Development of a methodology and a software (**ELER**) for rapid estimation of earthquake shaking and losses throughout the Euro-Mediterranean region

- KOERI – TURKEY

http://www.koeri.boun.edu.tr/sismo/eler/list_eq.htm

http://www.neries-eu.org



Shake Maps – Implementations

http://www.emsc-csem.org/Earthquake/earthquake.php?id=262443#map

European-Mediterranean Seismological Centre (EMSC)

PGA map using **synthetic** data

Estimation very close to the earthquake source

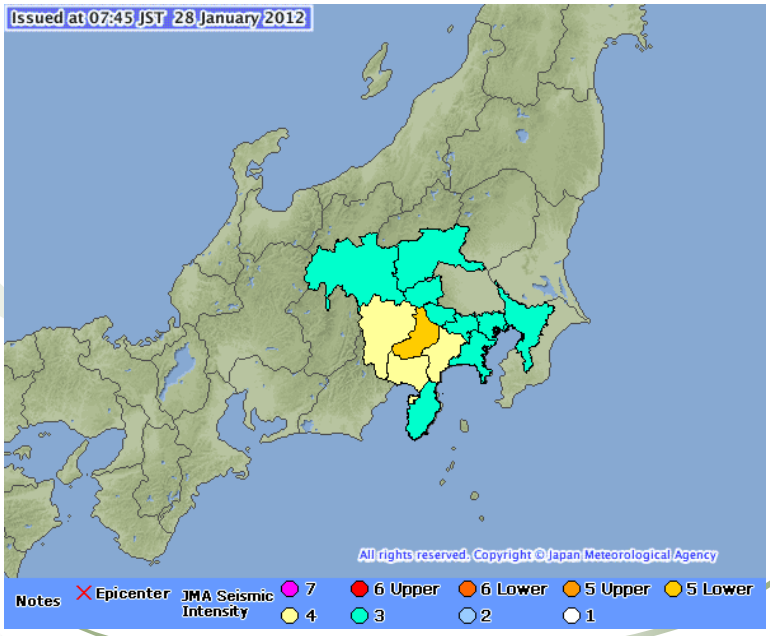
Shake Maps – Implementations

http://www.jma.go.jp/en/quake/quake_sindo_index.html

Japan Meteorological Agency (JMA) - JAPAN

気象庁
Japan Meteorological Agency

Intensity map automatically aired on national TV network after big events



Presentation Outline

1. Shake Maps – What are they?
2. Shake Maps Service Implementations
3. **EPPO Shake Maps Service**
4. Conclusion

EPPO Shake Maps Service

Target: A Web GIS Service to provide Shake Maps in Near-Real Time. Shake Maps include spatial distribution of PGA, PGV, PSA and Instrumental Intensity and might change in time depending on information available.

Calculation Method:

Using Real Data with Attenuation Relations

- Synthetic PGA (Ground Motion Prediction Equations) and Observed PGA (corrected)

+

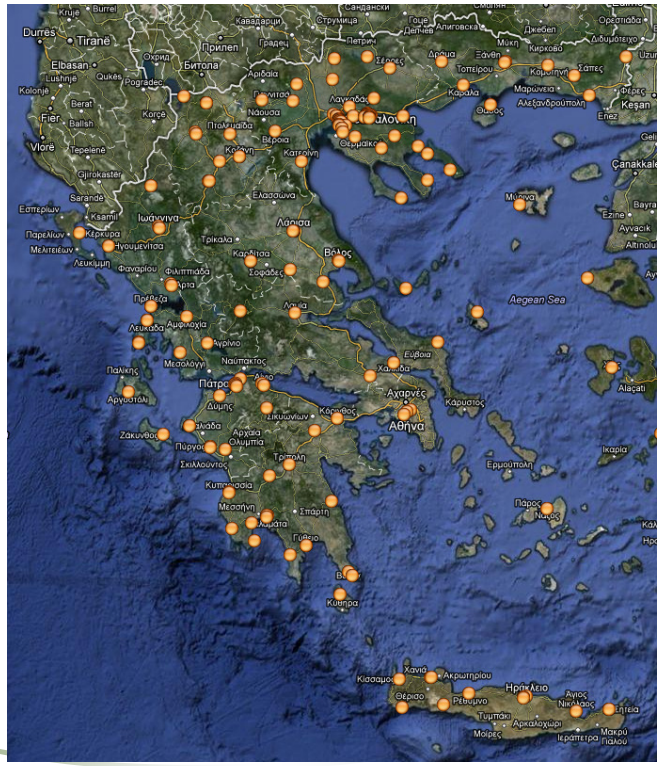
- Site Effect Corrections

EPPO Shake Maps Service

The Infrastructure

A dense Network of Accelerometers (instruments measuring ground motion) all over the Greek Region

Currently **173** instruments



EPPO Shake Maps Service

The data

- About 80 instruments with Internet connectivity (and increasing) and 100 more with dial-up
- Real Time Data Acquisition (continuous stream)
- Automatic extraction of event records based on earthquake catalogue
- Automatic extraction of event parameters (PGA, PGV, spectral response)

EPPO Shake Maps Service

The software

- Option 1: Develop a new solution from scratch
- Option 2: Use and adapt an existing solution

Option 2 has many advantages, like:

- Far more economical
- Far shorter implementation cycle

The USGS *ShakeMap* & KOERI *ELER* softwares were evaluated

EPPO Shake Maps Service

The USGS *ShakeMap* software was adopted:

- Already used by a number of European Organizations
- Uses an internationally well accepted scientific approach
- Open Source code available for download
- Open Source platform (no costs for licenses)
- Maturity (running since 2005)
- Stable code, maintained and supported
- Newer versions becoming available
- Good documentation

EPPO Shake Maps Service

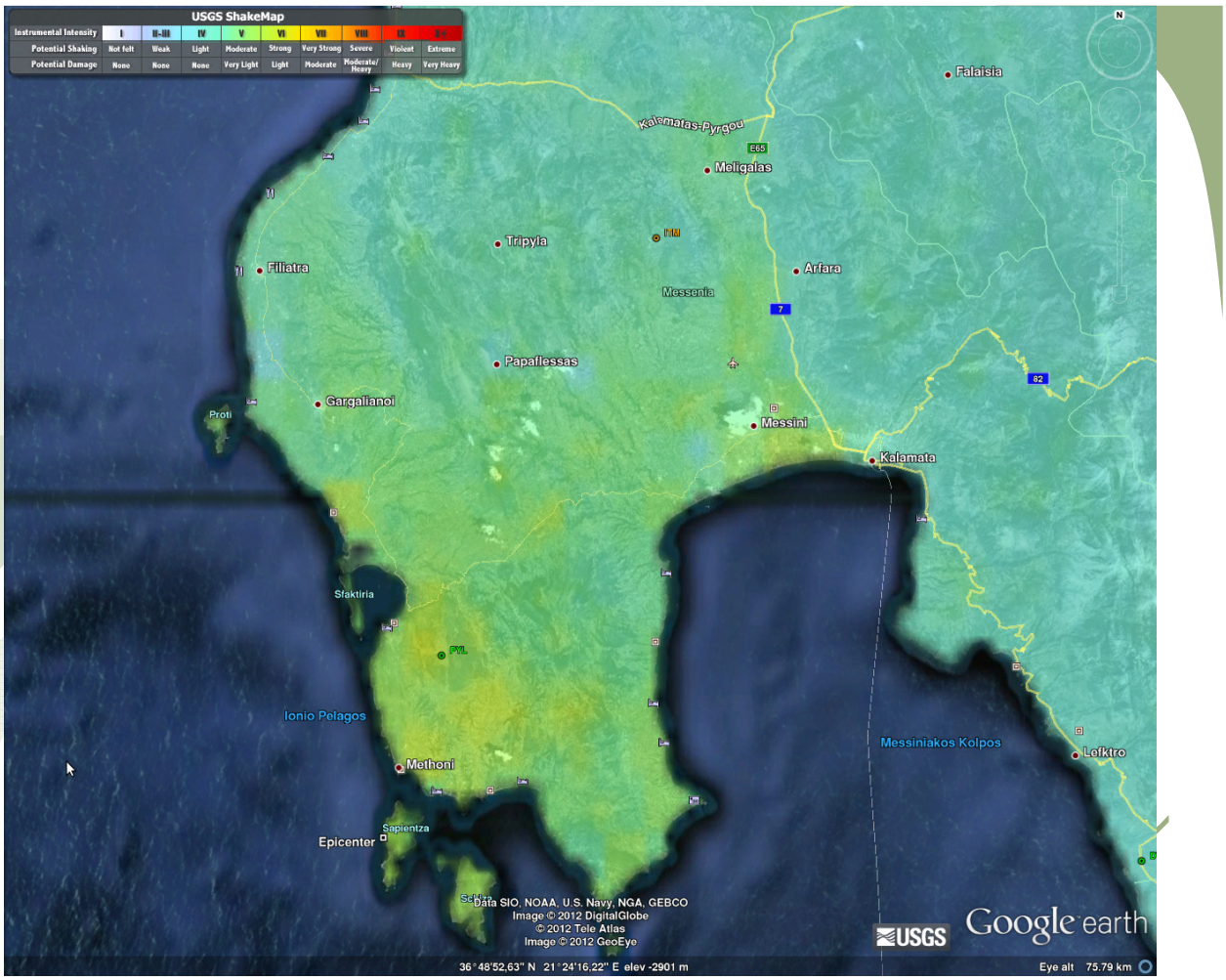
USGS *ShakeMap* features

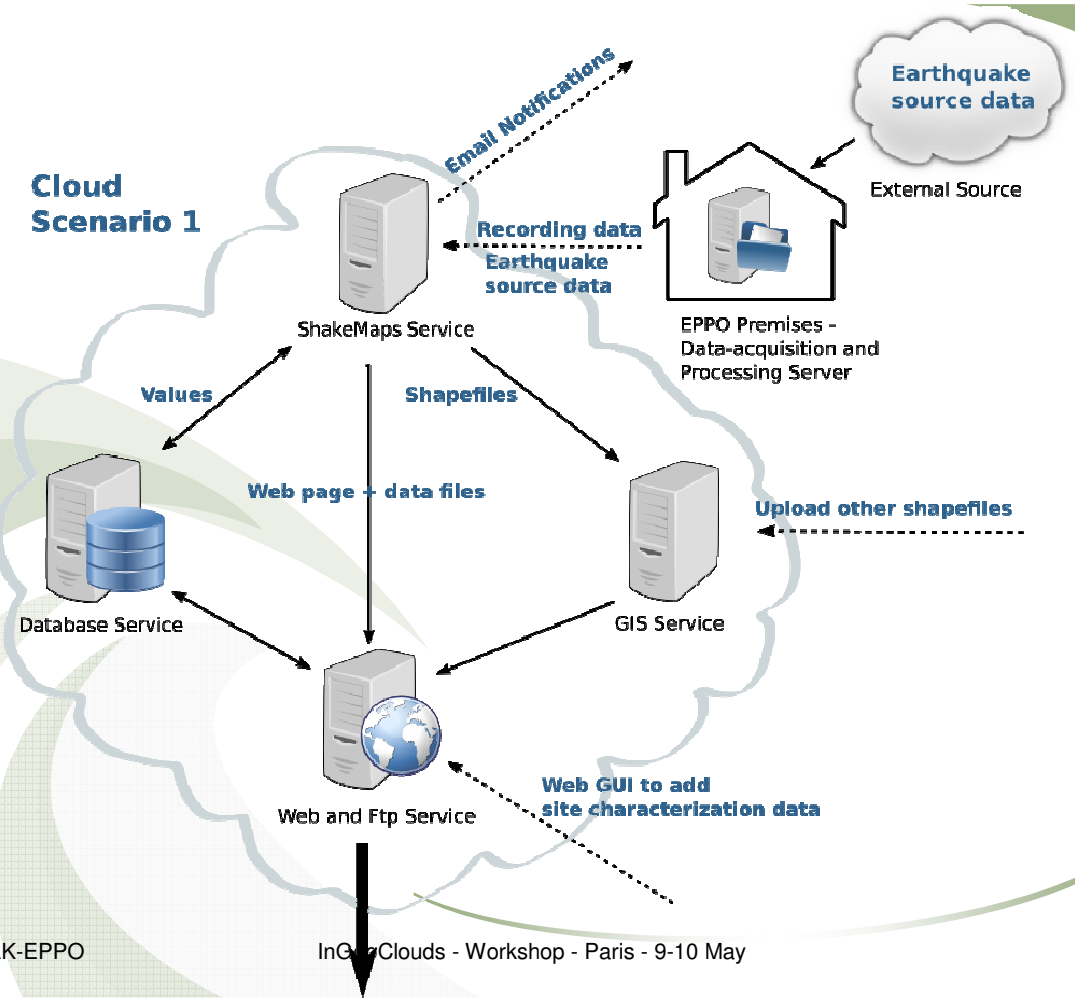
- Triggered by an external event
- Automatic production of the Shake Map
- Automatic production of a web page tree for immediate web publishing
- Automatic notification of interested parties
- Maps of various quantities (Peak Ground Acceleration - PGA, Peak Ground Velocity - PGV, Instrumental Intensity, Spectral response)
- Outcome available in many formats (Raw Grid, JPG, Shape Files, KML, Hazus files, XML) for further processing

EPPO Shake Maps Service

Shake Map Calculation Roadmap

- Software gets triggered by an external event
- Event recordings get extracted in an automatic way from continuous data stream
- Event parameters are extracted from recordings and fed as input to *ShakeMap* Software
- Shake Map is calculated and web page is produced
- Web page is automatically published
- Shake Map in the form of a shape file is displayed over a GIS map
- Interested parties get automatically notified





Extensions

- Loss estimation using fragility curves (for various types of structures - transport networks)
- 1D-3D Synthetic Forward Modeling using also rapture information

Presentation Outline

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Conclusion

Up to now there are a few national shake map service implementations

Others are on their way

However, it would be interesting to see a pan-european shakemaps service the same way we see a pan-european earthquake catalogue service (EMSC).

Feel free to contact us for further information

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  alexandros@itsak.gr

Thank you !

Questions ??