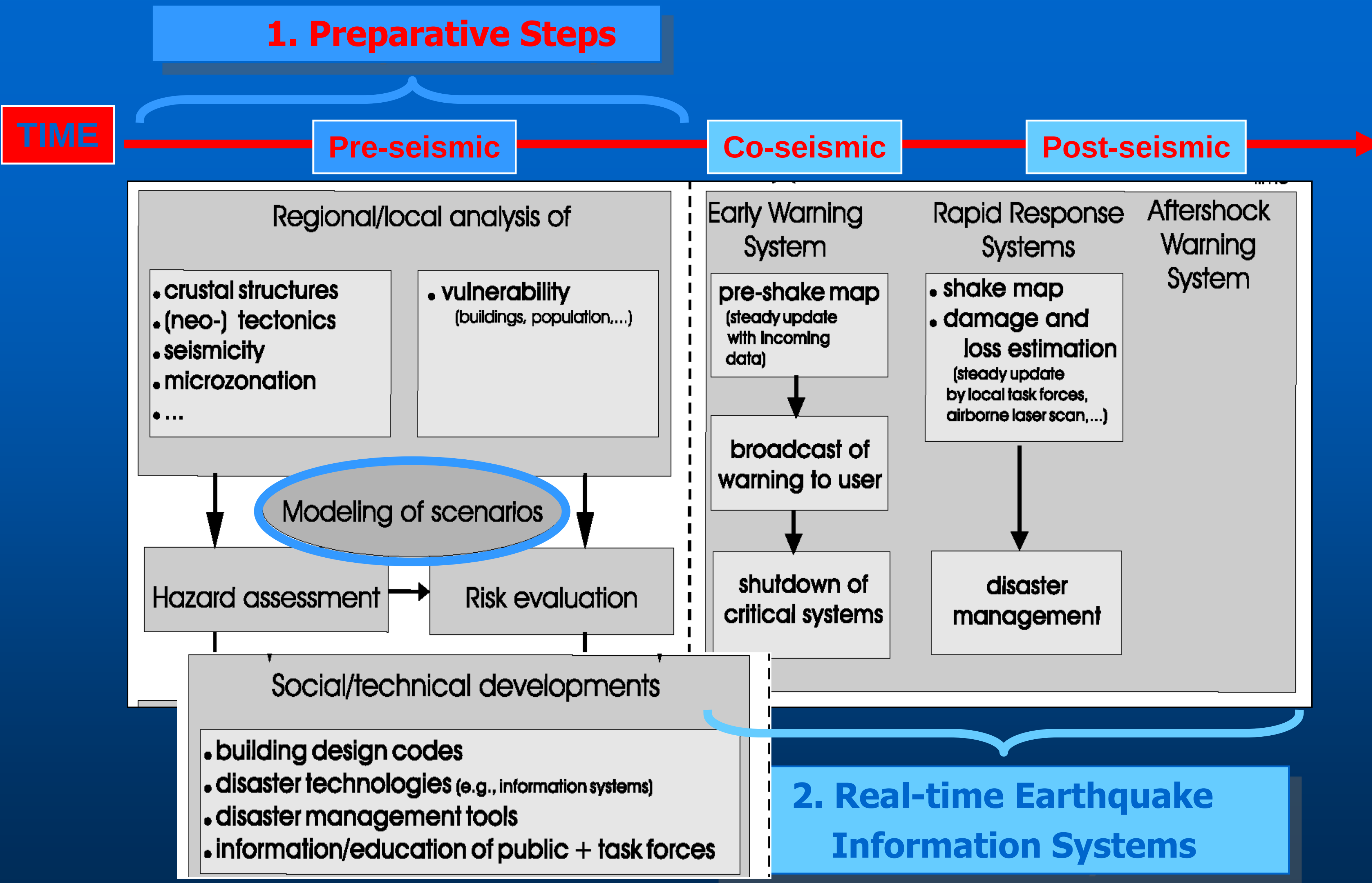
Post Earthquake Rapid Loss Assessment

SciNetNatHazPrev - PROJECT WORKSHOP

MARCH 13-14, 2014
ISTANBUL, TURKEY

VENUE: MAÇKA SOCIAL CENTER, ISTANBUL TECHNICAL UNIVERSITY FOUNDATION



After Böse (2006)

Loss Modeling is a tool to estimate the loss to a portfolio following a catastrophic earthquake

- Earthquake Hazard
- Exposure (Portfolio Inventory, Structure / Contents values, Policy Conditions)
- Fragility and Vulnerability (Hazard Susceptibility: Structural Taxonomy)

All Loss Models are simple mathematical models of the complex phenomena and encompass uncertainty.

- Aleatory = inherent randomness which can be accounted but cannot be reduced
- Epistemic = uncertainty due to lack of information which can possibly be reduced

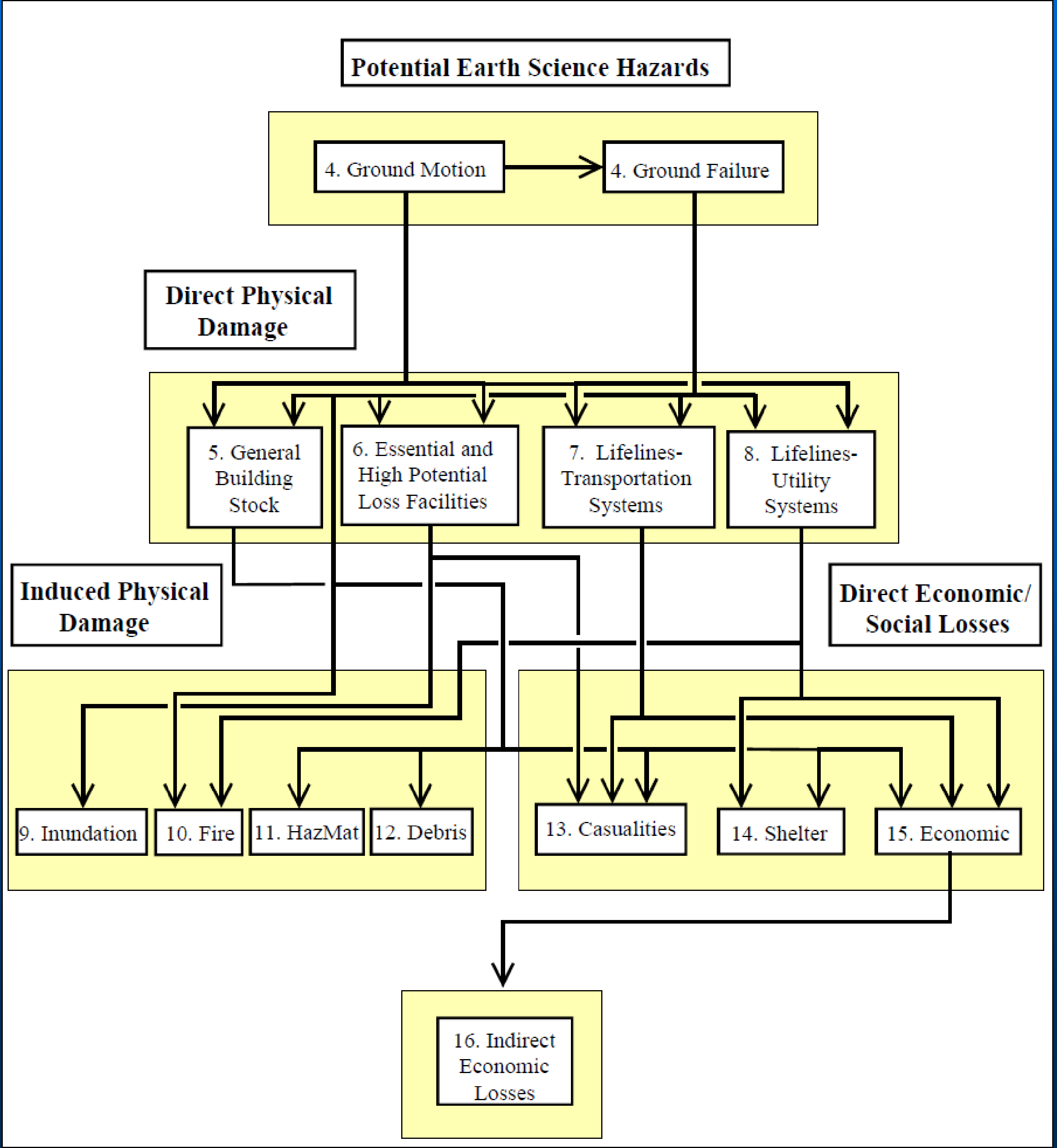
Main Sources of model uncertainty are due to: Limited portfolio data, Engineering/scientific assumptions and Probabilistic approaches.

Primary uncertainty is the uncertainty asssociated with the occurrence of the earthquake

Secondary uncertainty uncertainty in the estimates of event losses

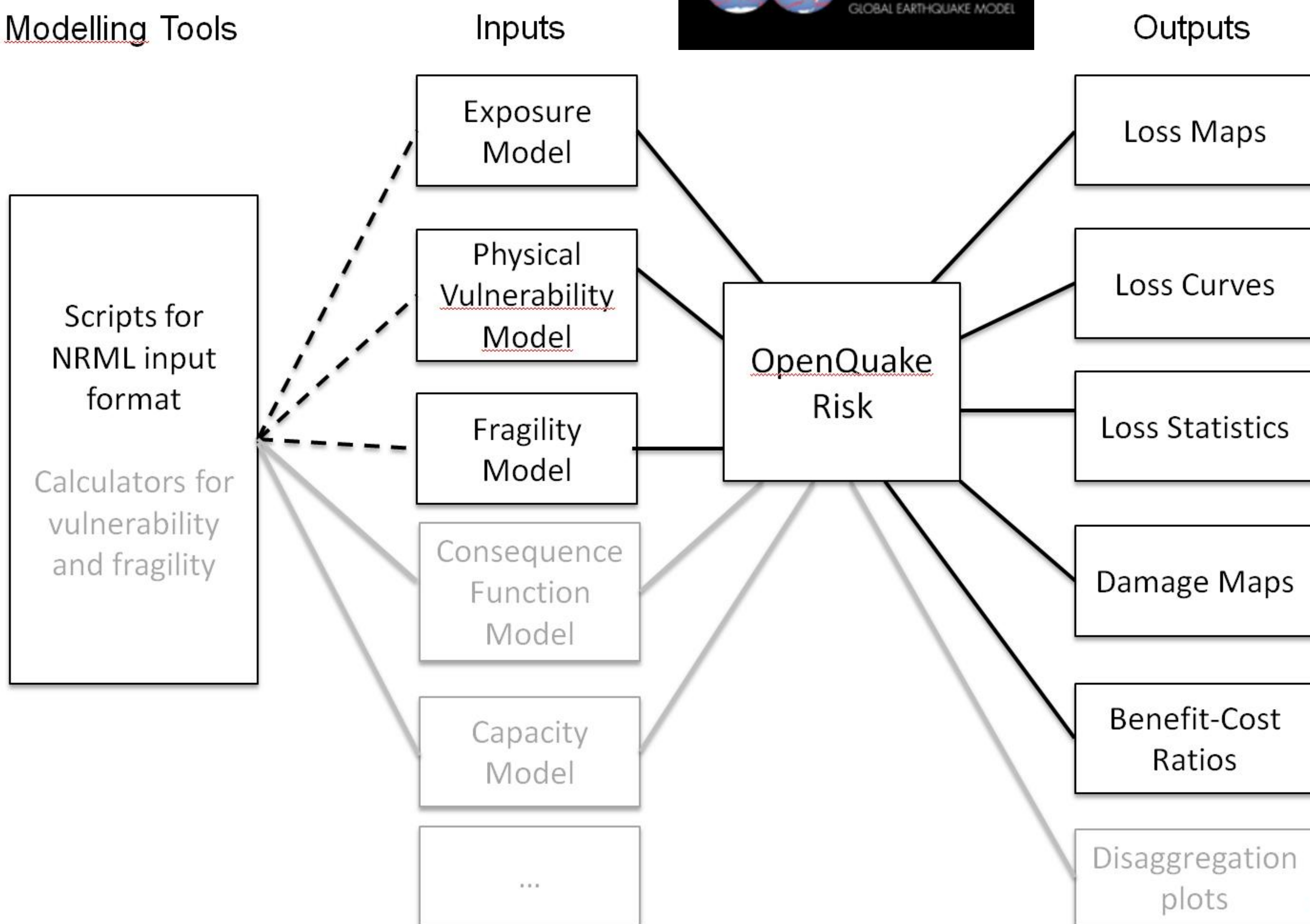
- Hazard uncertainty
- Vulnerability uncertainty
- Portfolio uncertainty

HAZUS®MH MR4



Potential Earth Science Hazards
4. Ground Motion
4. Ground Failure
Direct Physical Damage
5. General Building Stock
6. Essential and High Potential Loss Facilities
7. Lifelines- Transportation Systems
8. Lifelines- Utility Systems
Induced Physical Damage
Direct Economic/ Social Losses
9. Inundation
10. Fire
11. HazMat
12. Debris
13. Casualities
14. Shelter
15. Economic
16. Indirect Economic Losses

OPENQUAKE - RISK



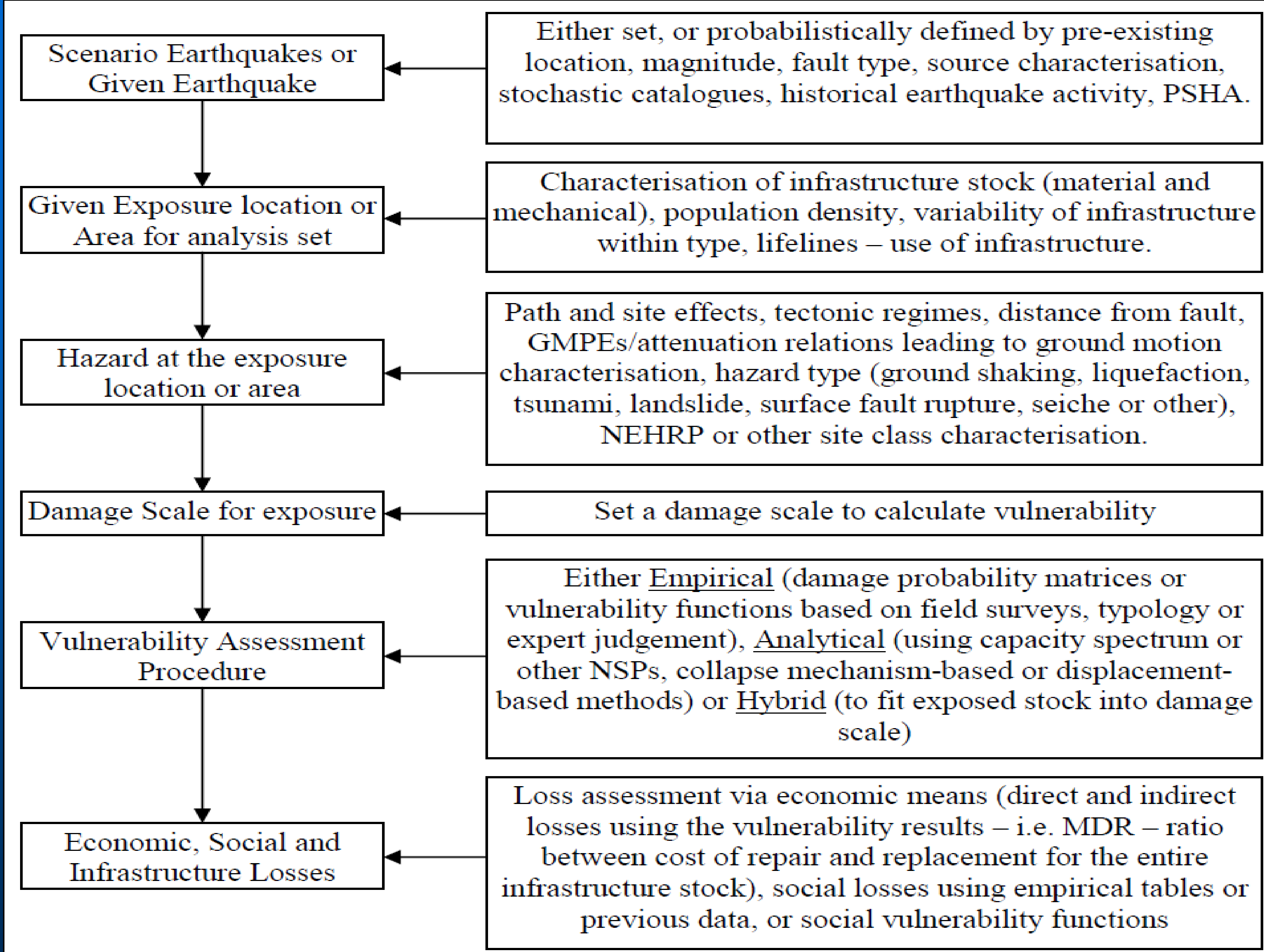
POST EARTHQUAKE RAPID LOSS ASSESSMENT

The reduction of casualties in urban areas immediately following an earthquake can be improved if the location and severity of damages can be rapidly assessed by the information from Rapid Loss Assessment Systems. Emergency management centers with functions in the immediate post-earthquake period (i.e. SAR, fire and emergency medical deployments) can allocate and prioritize resources to minimize the loss of life.

Available near real time loss estimation tools can be classified under two main categories depending on the size of area they cover: (1) Global/Regional Systems and (2) Local Systems.

For the global or regional near real time loss estimation efforts, Global Disaster Alert and Coordination System (GDACS), World Agency of Planetary Monitoring Earthquake Risk Reduction (QLARM), Prompt Assessment of Global Earthquakes for Response (PAGER) and Earthquake Loss Estimation Routine (ELER) can be listed.

Several local systems capable of computing damage and casualties in near real time already exist in several cities of the world such as Yokohama, Tokyo, Istanbul, Taiwan, Bucharest and Naples.



Identified Components of an Earthquake Loss Assessment (Rapid-Response, Post- or Pre- Earthquake) *(Daniell, 2009)*

Various worldwide rapid earthquake loss estimation software packages *(Daniell et al, 2011)*

Name	Database	Vuln. Type	Spatial	Population	Exposure
EXTREMUM	QUAKELOSS	Hybrid	Russian now Worldwide	Point-based	Population+Buildings
QUAKELOSS	QUAKELOSS	Hybrid	Worldwide	Point-based	Population+Buildings
PAGER-Empirical	PAGER-CAT	Empirical	Worldwide	Landscan	Population
PAGER-Semi-empirical	PAGER-CAT	Hybrid	Worldwide	Landscan	Population+Buildings
PAGER-Analytical	-	Analytical	Worldwide	Landscan	Population+Buildings
ELER-Level 0	Badal and Samardzhieva	Empirical	European	Landscan	Population
ELER-Level 1	Coburn+Spence	Hybrid	European	Landscan	Population+Buildings
ELER-Level 2	-	Analytical	European	Landscan	Population+Buildings
QLARM	QUAKELOSS2	Hybrid	Worldwide	Point-based	Population+Buildings
EQLIPSE–Q	CATDAT	Empirical	Worldwide	Point-based and Grid	Population+Buildings
EQLIPSE–R	CATDAT	Hybrid	Worldwide	Point-based and Grid	Population+Buildings

WAPMERR-QLARM World Agency of Planetary Monitoring and Earthquake Risk Reduction

QLARM (http://qlarm.ethz.ch) provides loss estimates for earthquakes in global scale after the event. The loss estimates are reportedly provided in about 30 minutes after the earthquake
This service is being carried out in partnership between WAPMERR (World Agency of Planetary Monitoring and Earthquake Risk Reduction) and the Swiss Seismological Service (SED-ETH, Zurich).
The estimates include: 1) The expected percentage of buildings in each of five damage states in each settlement, 2) the mean damage state in each settlement, 3) the numbers of fatalities and injured, with error estimates, in each settlement.

The European Macroseismic Method of Giovinazzi (2005) is used to calculate building damages. The fragility models are pertinent to EMS-98 fragility classes.
The probability of occurrence of casualty state for a given seismic intensity is calculated as a product of the damage probabilities for seismic intensity and the casualty probabilities for damage grades of EMS-98.

It is claimed that the human losses are estimated within a factor of 2 for past earthquakes.

What is QLARM?

QLARM is a computer tool to estimate building damage and human losses due to earthquakes anywhere in the world.

The input needed for a loss calculation is the earthquake origin hour, the coordinates of the epicenter, the depth and the magnitude. The program then calculates the ground shaking as a function of distance from the epicenter. In the data base of QLARM, the population of about 2 million settlements is known and each settlement has a profile of building fragility. The degree of damage due to the calculated shaking is determined for each of five fragility classes, and from that the resulting numbers of fatalities and injured are estimated.

The most accurate results could be obtained if the building inventory had been compiled by engineers on the ground. However, this is not possible for most cities, especially in developing countries. For this reason, the building fragilities have been calibrated, using about 1000 earthquakes for which losses are known. Therefore, QLARM estimates are most reliable in countries where earthquakes occur frequently. The building stock in countries without recent earthquakes is extrapolated from neighboring areas with similar building style and quality.

A true test of the performance is provided by **real-time estimates** because no adjusting of parameters is possible to achieve the correct results. The real-time estimates are usually distributed by email and telephone call less than 30 minutes after an earthquake occurs. They can assist rescue teams to make a decision whether or not to mobilize. Recent alerts can be seen **on our website including maps.**

QLARM

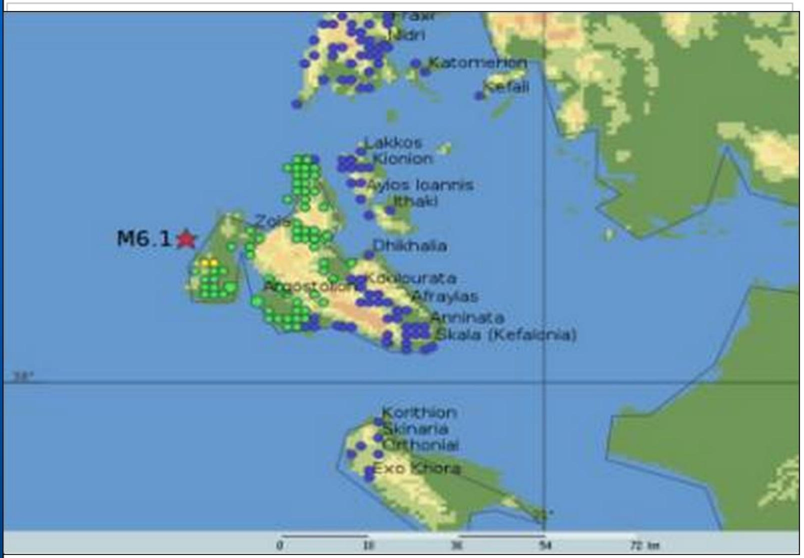
Earthquake Loss Estimate

The following Earthquake has been Reported:
Origin Time: 2014/02/03 03:08:46.0
Region: GREECE
Latitude: 38.2924 N
Longitude: 20.3373 E
Magnitude: 6.1 M
Depth: 13.7 km
Source: USGS/GFZ

ESTIMATE OF HUMAN LOSSES
Injured Exp. min/max: 0/130
Fatalities Exp. min/max: 0/50

ALERT LEVEL

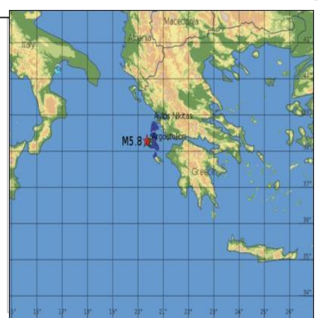
MAP OF MEAN DAMAGE BY SETTLEMENT



LEGEND

- Epicenter
- **Damage and Population**
  - mean Damage 0.01 - 0.5
  - mean Damage 0.5 - 1.5
  - mean Damage 1.5 - 2.5
  - mean Damage 2.5 - 3.5
  - mean Damage 3.5 - 4.5
  - mean Damage > 4.5
  - Population 1 - 3,000
  - Population 3,000 - 30,000
  - Population 30,000 - 300,000
  - Population 300,000 - 3. Mil.
  - Population > 3 Mil.

REMARKS: If the hypocenter is below the island and really shallow, it could be worse



ESTIMATED EXPOSURE

Intensity	Population
V	15872
VI	23349
VII	18386
VIII	
IX	
X	
XI	
XII	

www.wapmerr.org

An earthquake ML5.8 occurred on Feb.3, 2014 03:08 in the Island of Kefalonia with structural damage (NOA)

Lon. 20.3913
Lat. 38.2628

SELENA - Seismic Loss Computation Engine

SELENA (Seismic Loss Estimation using a Logic Tree Approach) is a software tool for seismic risk and loss assessment.
It relies on the principles of capacity spectrum methods (CSM) and follows the same approach as the loss estimation tool for the United States HAZUS-MH (2003).
A logic tree-computation scheme has been implemented in SELENA to account for epistemic uncertainties in the input data. The user has to supply a number of input files that contain the necessary input data (e.g., building inventory data, demographic data, definition of seismic scenario etc.) in a simple pre-defined ASCII format. SELENA computes ground shaking maps for various spectral periods (PGA, Sa(0.3 s) and Sa(1.0 s), damage probabilities, absolute damage estimates (including Mean Damage Ratios MDR) as well as economic losses and numbers of casualties.
SELENA can compute the ground motion parameters by built-in GMPRs for deterministic scenario earthquakes. For real time analysis, data from strong motion stations (at least PGA values) can also be used with certain limitations. Based on these ground motion parameters SELENA generates site-specific response spectra

PAGER (Prompt Assessment of Global Earthquakes for Response)

PAGER (USGS, USAID) is an automated system that produces content concerning the impact of significant earthquakes around the world, informing emergency responders, government and aid agencies, and the media of the scope of the potential disaster. PAGER has three separate methodologies for earthquake loss estimation as part of their package (empirical, semi-empirical and analytical).

PAGER rapidly assesses earthquake impacts by comparing the population exposed to each level of shaking intensity with models of economic and fatality losses based on past earthquakes in each country or region of the world.

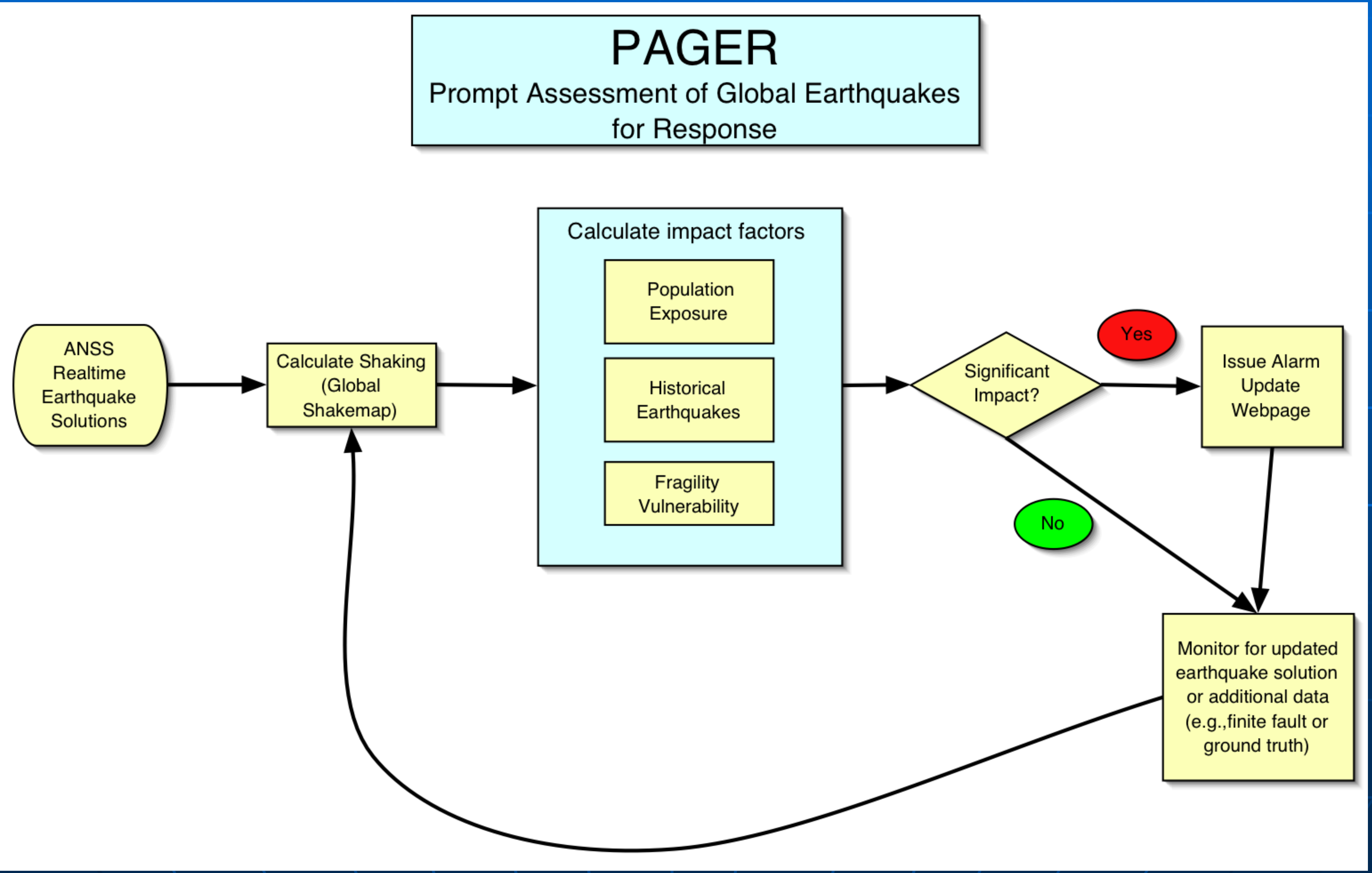
PAGER information are generated for all earthquakes of magnitude 5.5 and greater globally and for lower magnitudes of about 3.5-4.0 within the US.

PAGER's results are posted on the USGS Earthquake Program Web site (http://earthquake.usgs.gov/) and sent in near real-time to emergency responders, government agencies, and the media.

In the hours following significant earthquakes, as more information becomes available, PAGER's content is modified.

Prompt Assessment of Global Earthquakes for Response

PAGER USGS/USAID



Databases, Products, Tools, and Services PAGER *(Wald et al, 2012)*

Database/Product	Description	Use	Reference
Earthquake Source			
Fast Finite Faults	Rapid slip models for major earthquakes	Compute shaking; tsunami, stress change	Ji et al (2004); Hayes & Wald (2008)
PAGER-Cat	Quality earthquake catalog (1900-2006)_	Input for ShakeMap Atlas; ExposureCat	Allen et al (2008a)
Shaking Distribution			
Global Slope Data	Topographic slope	Landslides, Vs30	Verdin et al (2007)
Global Vs30 Server	Vs30 values for the globe	Estimating site amplification	Allen & Wald (2008); Wald & Allen (2008)
Global "Did You Feel It" Intensities	Rapid intensities from Internet users	Constrains Shake-Map & event bias	Wald et al (2006b); Wald et al (2008b)
Ground Motion/ Intensity Relations	New relations relating ground motion & intensity	Relate MMI to peak motions	Gerstenberger et al (2009)
ShakeMap Uncertainty	Quantitative & Qualitative shaking values	Computing loss uncertainty	Wald et al (2008b)
ShakeMap Atlas	ShakeMaps for global earthquakes (1970-on)	Scenarios, planning, hazard calculations	Allen et al (2008c)
Rapid Global ShakeMaps (GSM)	Estimated ShakeMaps for all global earthquakes (M>5.5)	Shaking input for loss estimation, decision making	Wald et al (2006a)

Databases, Products, Tools, and Services PAGER *(Wald et al, 2012)*

Database/Product	Description	Use	Reference
Loss & Impact Estimation			
Deadly Earthquake List	Online resource list (1900-2006)	General Reference	On Wikipedia: see "List of Deadly Earthquakes"
Exposure-Cat	Population exposed per intensity for each Atlas ShakeMap	Fatality rates calculations	Allen et al. (2008a)
Global Building Inventory	Country-based data on buildings & collapse rates	Country-specific loss estimation	Jaiswal & Wald (2008b); Porter et al (2008a)
Empirical Loss Model	Country-specific fatality rates	Fatality estimates given exposure	Porter et al (2008a) Jaiswal et al (2008a)
Semi-Empirical Loss Model	Country-specific, building vulnerability	Fatality estimates based on structures	Jaiswal et al (2008b)
Analytical Loss Model	HAZUS vulnerability functions	Structure dependent loss computations	Porter (2008); Porter et al (2008a)
Reporting & Notifications			
OnePAGER	Population Exposure Notifications	Post-earthquake decision making	Earle & Wald (2007)

== PRELIMINARY EARTHQUAKE REPORT ==

Region: GREECE
Geographic coordinates: 38.292N, 20.337E
Magnitude: 6.1
Depth: 13 km
Universal Time (UTC): 3 Feb 2014 03:08:46
Time near the Epicenter: 3 Feb 2014 05:08:46
Local standard time in your area: 3 Feb 2014 05:08:46

Location with respect to nearby cities:
12 km (7 mi) NW of Lixourion, Greece
74 km (45 mi) NW of Zakynthos, Greece
81 km (50 mi) SSW of Preveza, Greece
95 km (58 mi) W of Mesolongi, Greece
298 km (184 mi) W of Athens, Greece

ADDITIONAL EARTHQUAKE PARAMETERS

event ID : us c000mfuh
version :
number of phases : 93
rms misfit : 1.02 seconds
horizontal location error : 0.0 km
vertical location error : 4.4 km
maximum azimuthal gap : 35 degrees
distance to nearest station : 186.9 km

USGS science for a changing world

Earthquake Shaking Yellow Alert

GSN ANSS USAID FROM THE AMERICAN PEOPLE

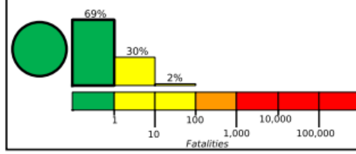
M 6.0, GREECE

Origin Time: Mon 2014-02-03 03:08:44 UTC (05:08:44 local)
Location: 38.23°N 20.38°E Depth: 8 km

PAGER Version 3

Created: 4 weeks, 4 days after earthquake

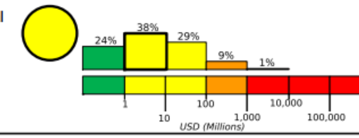
Estimated Fatalities



Yellow alert level for economic losses. Some damage is possible and the impact should be relatively localized. Estimated economic losses are less than 1% of GDP of Greece. Past events with this alert level have required a local or regional level response.

Green alert level for shaking-related fatalities. There is a low likelihood of casualties.

Estimated Economic Losses



Estimated Population Exposed to Earthquake Shaking

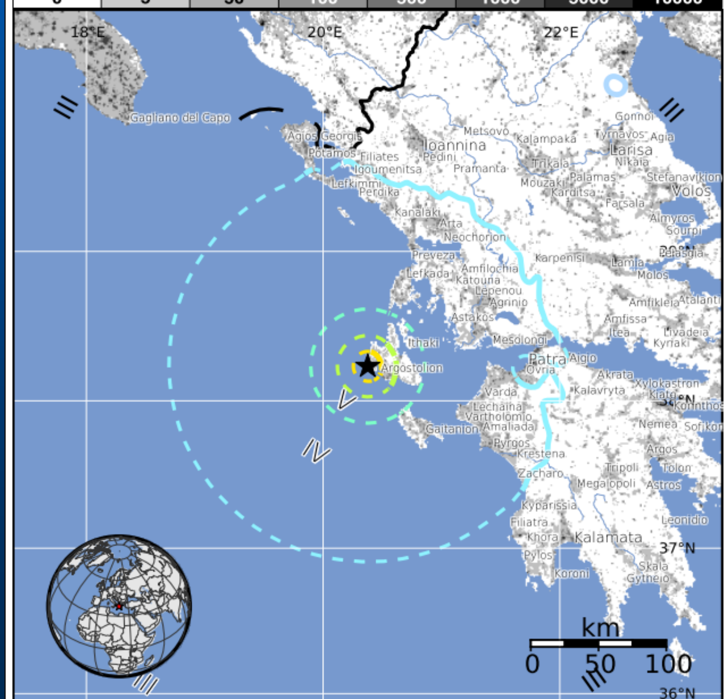
ESTIMATED POPULATION EXPOSURE (k = x1000)		--*	4,076k*	817k	12k	19k	10k	0	0	0
ESTIMATED MODIFIED MERCALLI INTENSITY		I	II-III	IV	V	VI	VII	VIII	IX	X+
PERCEIVED SHAKING		Not felt	Weak	Light	Moderate	Strong	Very Strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	Resistant Structures	none	none	none	V. Light	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy
	Vulnerable Structures	none	none	none	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy	V. Heavy

*Estimated exposure only includes population within the map area.

Population Exposure

population per ~1 sq. km from Landscan

0	5	50	100	500	1000	5000	10000



Structures:
Overall, the population in this region resides in structures that are a mix of vulnerable and earthquake resistant construction.

Historical Earthquakes (with MMI levels):

Date (UTC)	Dist. (km)	Mag.	Max MMI(#)	Shaking Deaths
1997-11-18	98	6.6	VII(6k)	0
1978-06-19	369	5.3	VII(3k)	1
1999-09-07	288	6.0	IX(10k)	143

Recent earthquakes in this area have caused secondary hazards such as landslides that might have contributed to losses.

Selected City Exposure

from GeoNames.org

MMI	City	Population
VII	Lixourion	4k
VI	**Argostolion**	10k
VI	Valsamata	1k
V	Sami	1k
V	**Ithaki**	2k
V	Poros	1k
III	**Patra**	163k
III	**Ioannina**	64k
III	**Larisa**	129k
III	**Lamia**	47k
III	Vlore	90k

bold cities appear on map (k = x1000)

PAGER content is automatically generated, and only considers losses due to structural damage. Limitations of input data, shaking estimates, and loss models may add uncertainty.
http://earthquake.usgs.gov/pager

Event ID: usc000mfuh

ELER: Earthquake Loss Estimation

Under the EU Project NERIES, a rapid loss estimation tool (ELER) is developed for rapid estimation of earthquake damages, casualties and shelters requirements throughout the Euro-Med Region by researchers from KOERI, Imperial College, NORSAR and ETH-Zurich.

The shake mapping methodology is similar to the USGS ShakeMap. Based on the event parameters the distribution of ground motion intensity parameters are estimated using GMPEs. If strong ground motion recordings are available, the prediction distributions are bias corrected.

Earthquake losses (damage and casualty) can be estimated at different levels of sophistication, namely Level 0, 1 and 2, depending on the resolution of building inventory data.

Both Level 0 (quite similar to PAGER system of USGS) and Level 1 analyses of ELER software are based on obtaining intensity distributions analytically and estimating total number of casualties either using regionally adjusted intensity-casualty or magnitude-casualty correlations (Level 0) or using regional building inventory databases (Level 1). These levels are used for rapid loss estimation.

NERIES – EU FP6 Network of Research Infrastructures in Earthquake Seismology

KOERI,Imperial College, NORSAR, EMSC, ITSAK, DPC-SSN, ICC, IST

ELER SOFTWARE

	LEVEL 0	LEVEL 1	LEVEL 2
HAZARD &	**Shakemap** (Point Source/Extended Source based on Seismotectonic Database +Vs30 →EMS98)	**Shakemap** (Point Source/Extended Source based on Seismotectonic Database +Vs30 →EMS98)	**Ground Motion Map** (Point Source/Extended Source based on rapid inversion +observed GM values +Vs30 →EMS98)
INVENTORY	City Locations + Landscan Population Distribution	Building Inventory (types and storey numbers) + Landscan Population Distribution	Building Inventory (types and storey numbers) + Landscan Population Distribution
BUILDING DAMAGE &	N/A	Building Damage using EMS98 Intensity based Building Vulnerability with Uncertainties.	Building Damage using Spectral Displacement based Building Vulnerability with Uncertainties.
CASUALTY	Regionally Adjusted Fatality vs EMS98 Relationships	Building Damage related Casualty Distribution	Building Damage related Casualty Distribution

ISTANBUL TESTBED EXERCISE COMPARISON OF LOSS RESULTS

A damage estimation exercise has been carried out using the building stock inventory and population database of the Istanbul Metropolitan Municipality and selected European earthquake loss estimation methodologies: KOERILOSS, SELENA, ESCENARIS, SIGE and DBELA.

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RESULTS FOR INTENSITY-BASED CALCULATIONS

Building Damage	EMS98 Damage Grade	KOERI-MSK	ESCENARIS Level 0	ESCENARIS Level 0	SIGE-DPC
HEAVY	D3	76,944	101,797	67,034	25,150 unusable (D4 + 40% D3) and 1,669 collapsed (D5)
BEYOND REPAIR	D4+D5	40,268	53,831	32,148	

RESULTS FOR SPECTRUM-BASED CALCULATIONS

Structural Damage	EMS98 Damage Grade	KOERI-SD	DBELA
MODERATE	D3	195, 097	200,918
EXTENSIVE	D4	67,395	81,497
COLLAPSE	D5	34,828	46,968

Evaluation of Seismic Risk Software

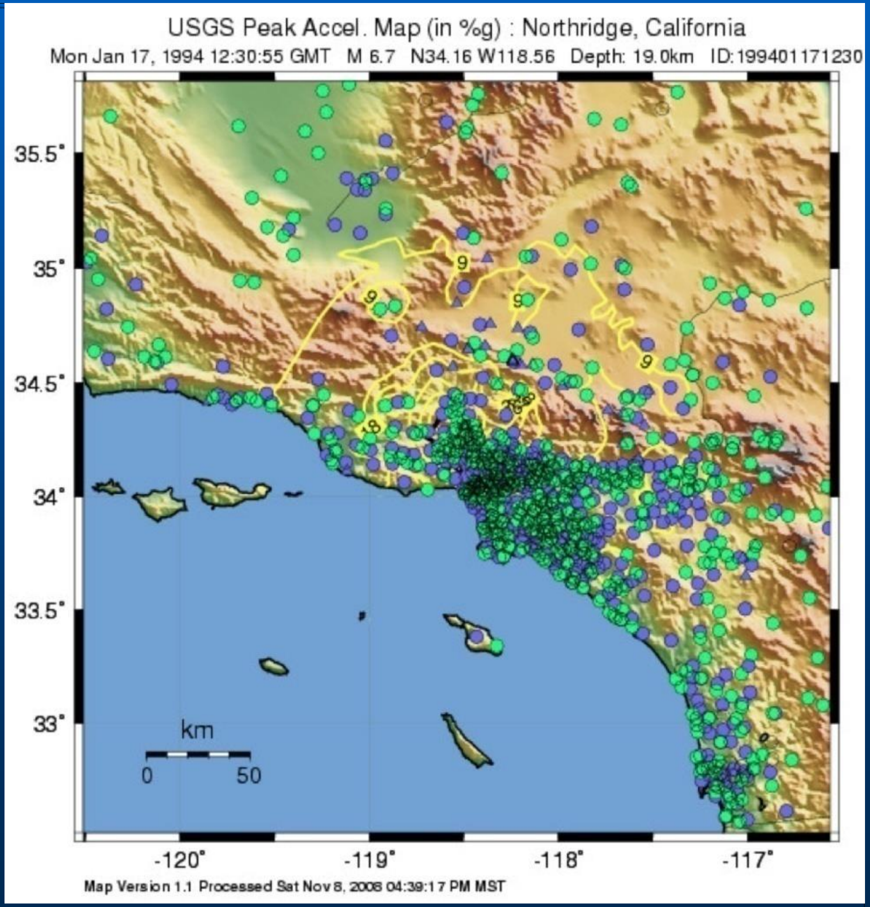
GEM1 Seismic Risk Software Comparison

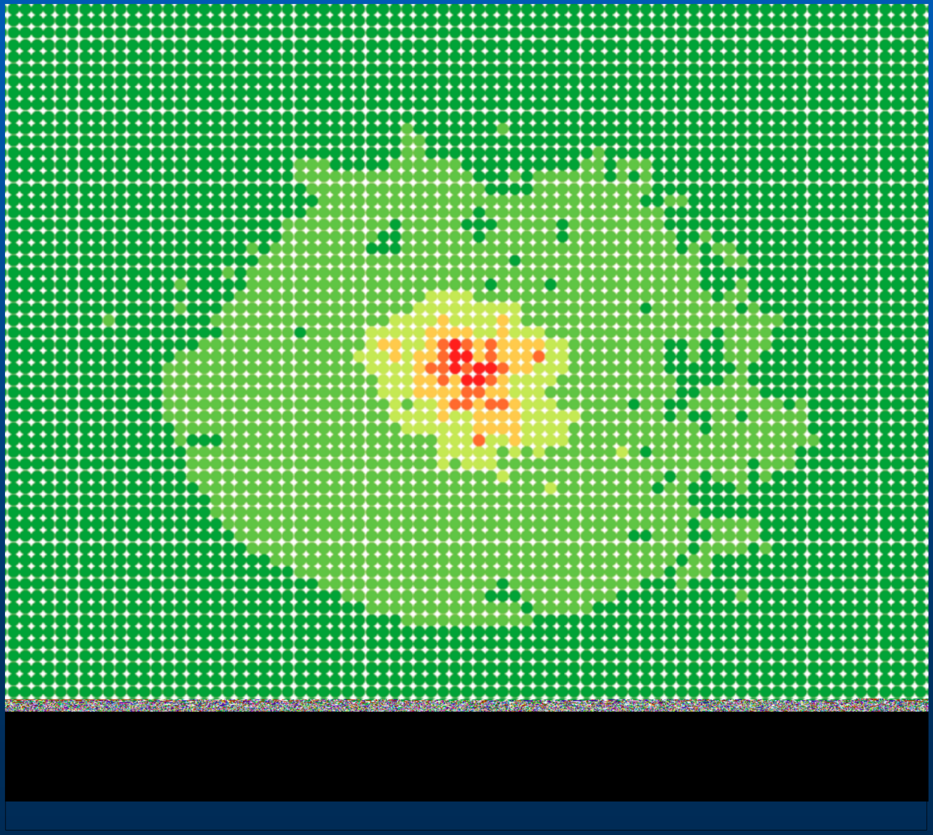
Software	Owner/Developer	Development status	Availability status	Applicabiity
SELENA	NORSAR	Version 4: matlab Version 5: C	Open source	User-defined
EQRM	Geoscience Australia	Version 1.0svn1393	Open source	Australia (default) User-defined
ELER	KOERI (NERIES project)	Version 2.0	Standalone application provided	Euro-med User-defined
QLARM	WAPMERR-SED-ETHZ	Version 1.1.7	Open source	Worldwide
CEDIM	CEDIM		Source code provided	User defined

Overview of Code Comparison

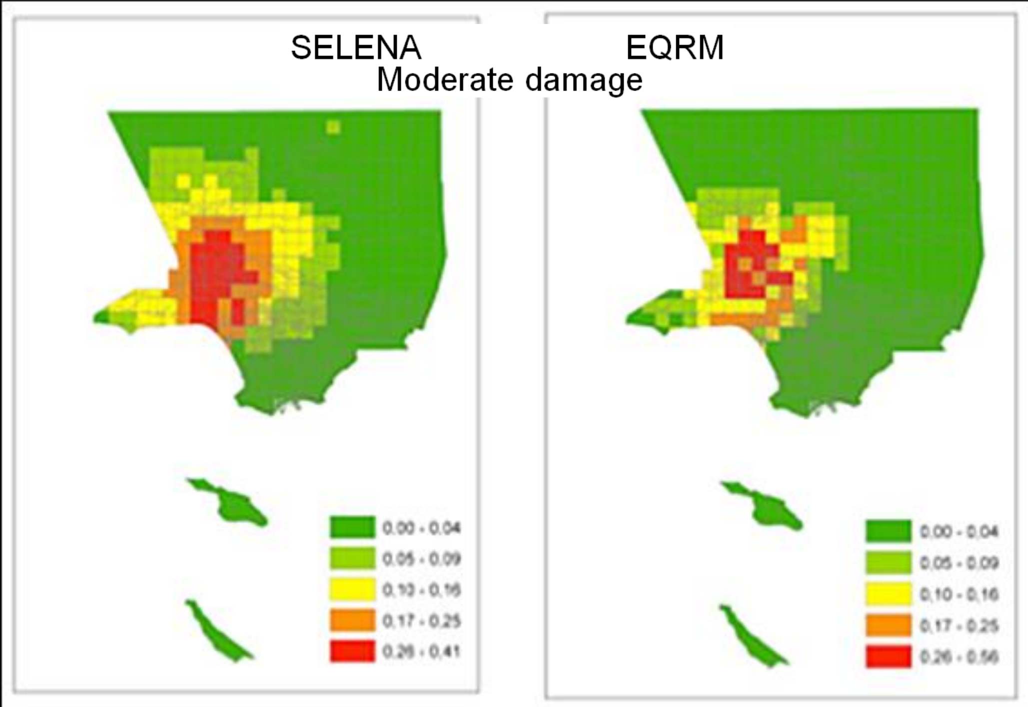
Test-Bed Application: Los Angeles

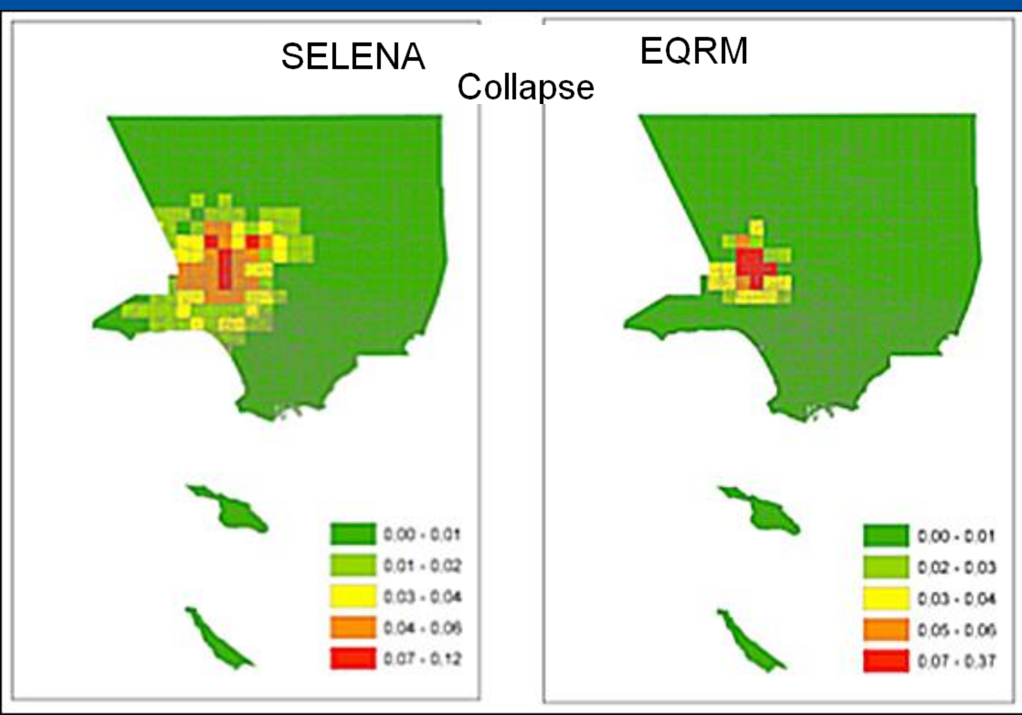
Scenario earthquake: Northridge, M=6.7, USGS ShakeMap:



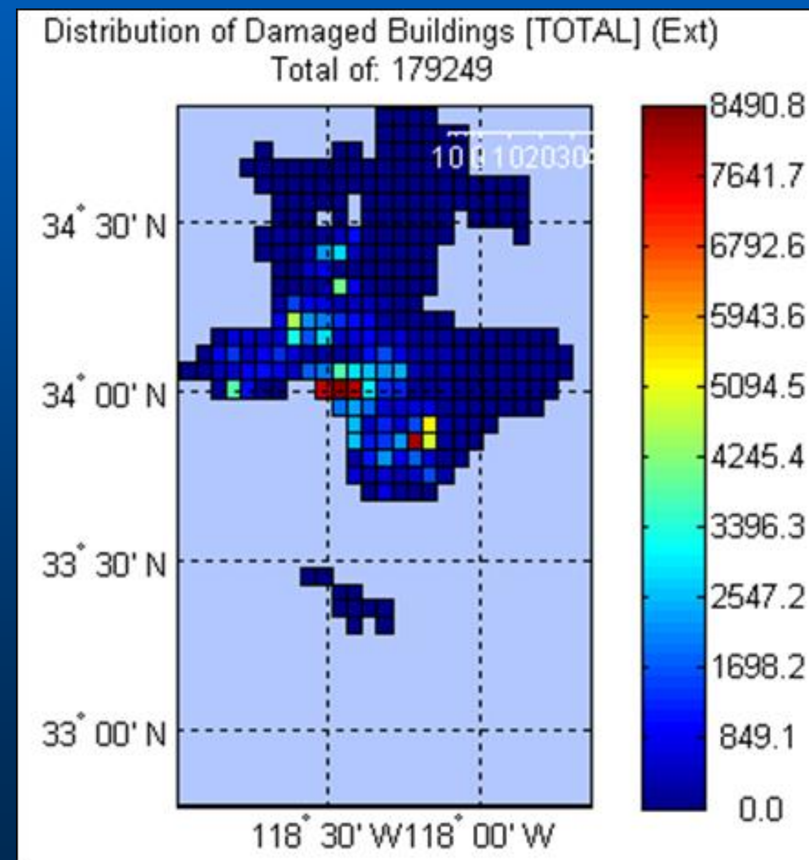


PGA ShakeMaps

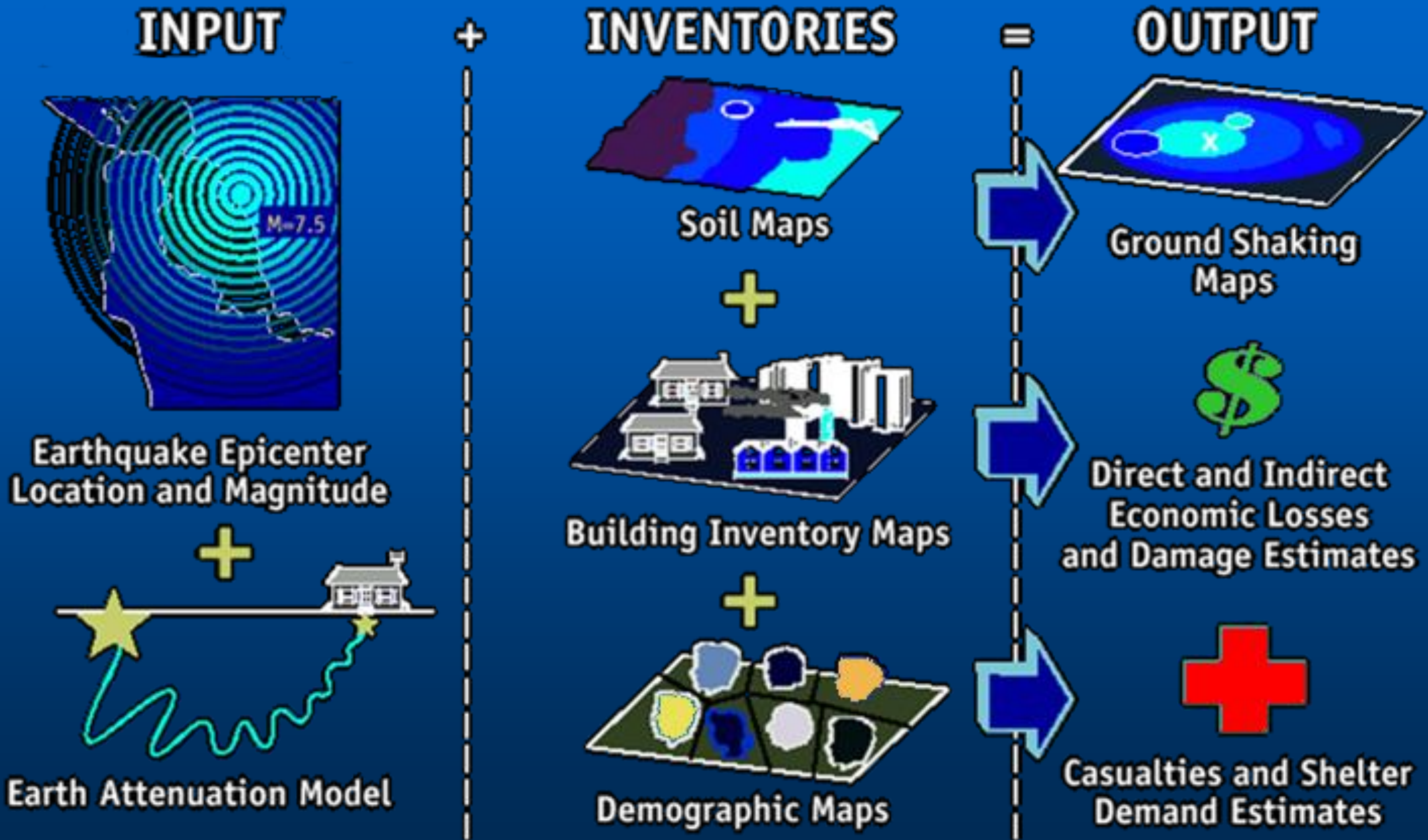

SELENA
EQRM
Moderate damage
0.00 - 0.04
0.05 - 0.09
0.10 - 0.16
0.17 - 0.25
0.26 - 0.41
0.00 - 0.04
0.05 - 0.09
0.10 - 0.16
0.17 - 0.25
0.26 - 0.56


SELENA
EQRM
Collapse
0.00 - 0.01
0.01 - 0.02
0.03 - 0.04
0.04 - 0.06
0.07 - 0.12
0.00 - 0.01
0.02 - 0.03
0.03 - 0.04
0.05 - 0.06
0.07 - 0.37

ELER


Distribution of Damaged Buildings [TOTAL] (Ext)
Total of: 179249
34° 30' N
34° 00' N
33° 30' N
33° 00' N
118° 30' W
118° 00' W
8490.8
7641.7
6792.6
5943.6
5094.5
4245.4
3396.3
2547.2
1698.2
849.1
0.0

RT-ELER


INPUT
+
INVENTORIES
=
OUTPUT
M=7.5
Earthquake Epicenter Location and Magnitude
+
Earth Attenuation Model
Soil Maps
+
Building Inventory Maps
+
Demographic Maps
Ground Shaking Maps
Direct and Indirect Economic Losses and Damage Estimates
Casualties and Shelter Demand Estimates

How does RT-ELER work?

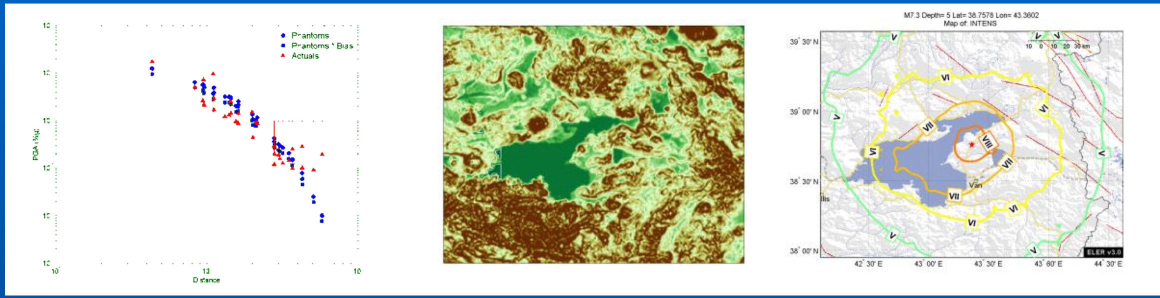
- **HAZARD**

Epicenter (KOERI)

GMPE (Boore & Atkinson 2007)

IMPE (Wald 1999)

Slobe Based Vs30 (Wald & Allen 2009)

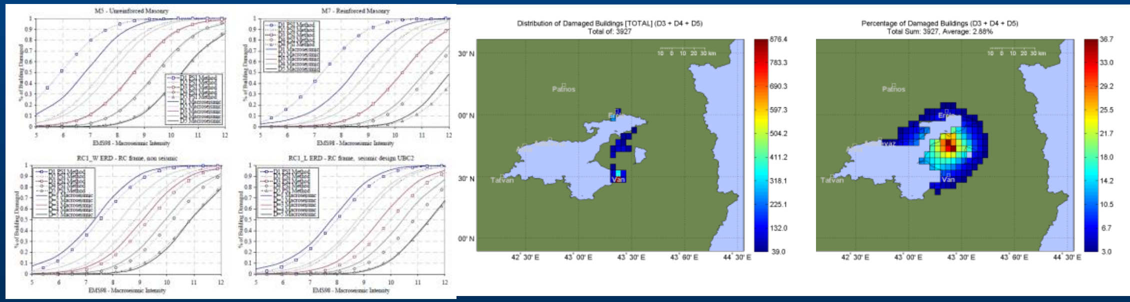


- **LOSS**

Building Inventory (KOERI)

Intensity Based Damage (Giovinazzi 2005)

Casualty Estimations (KEORI 2002)



Kandilli.info

http://www.koeri.boun.edu.tr/sismo/eler/index.html

Tarih	Saat	Enlem	Boylam	Derinlik	MD	ML	Mw	Siddet	Yer
2014.03.04	17:15:46	38.8623	43.6422	5	-.-	3.3	-.-	III	KELLE-(VAN)
2014.03.04	16:11:17	38.8502	43.6558	6	-.-	3.5	3.6	III	KELLE-(VAN)
2014.03.03	16:14:49	38.4362	45.136	5	-.-	3.0	-.-	II	IRAN
2014.03.02	23:15:16	41.7402	43.1098	5.3	-.-	3.4	-.-	III	GURCISTAN
2014.03.02	07:33:16	36.786	35.1547	9.4	-.-	3.0	-.-	III	YASSIOREN-KARATAS (ADANA)
2014.03.02	06:29:09	36.7735	35.1567	13	-.-	3.5	-.-	III	DAMLAPINAR-KARATAS (ADANA)
2014.03.02	06:25:57	36.7853	35.1752	6.7	-.-	4.0	-.-	IV	KEFELI-TARSUS (MERSIN)
2014.03.02	05:34:27	44.4127	34.3493	63.1	-.-	4.1	-.-	IV	KARADENIZ
2014.03.01	17:38:27	35.142	27.413	11.2	-.-	3.2	-.-	III	MEDITERRANEAN SEA
2014.03.01	12:54:50	39.3765	44.4453	8.4	-.-	3.0	-.-	III	SARICAVUS-DOGUBAYAZIT (AGRI)
2014.03.01	02:09:25	34.1795	26.1847	97	-.-	3.4	-.-	III	GIRIT ADASI ACIKLARI (MEDITERRANEAN SEA)
2014.03.01	00:13:53	38.258	22.4632	12.7	-.-	3.6	-.-	III	YUNANISTAN
2014.02.28	17:35:15	41.1922	25.482	11.7	-.-	3.3	-.-	III	YUNANISTAN
2014.02.28	15:16:57	39.2738	29.2982	5	-.-	3.6	-.-	III	KIRGIL-EMET (KUTAHYA)
2014.02.28	05:51:48	36.0488	25.0797	8.3	-.-	4.0	-.-	III	GIRIT ADASI (MEDITERRANEAN SEA)
2014.02.27	21:16:55	35.5582	23.4047	30.9	-.-	3.8	-.-	III	GIRIT ADASI (MEDITERRANEAN SEA)
2014.02.27	10:09:22	39.0262	30.0553	5	-.-	3.9	-.-	IV	KARAAGAC-ALTINTAS (KUTAHYA)
2014.02.27	10:03:58	39.006	30.0305	5	-.-	3.0	-.-	III	KARAAGAC-ALTINTAS (KUTAHYA)
2014.02.27	09:59:54	39.0097	30.0587	6	-.-	3.9	3.8	III	KARAAGAC-ALTINTAS (KUTAHYA)
2014.02.26	14:10:42	38.884	42.3702	5	-.-	3.0	-.-	II	GOLGOREN-AHLAT (BITLIS)
2014.02.26	09:34:17	41.0367	39.0897	11.5	-.-	3.0	-.-	II	KEKIKTEPE-EYNESIL (GIRESUN)

RT ELER asagidaki deprem icin calismistir / RT ELER was triggered by the following event

Aletsel Buyukluk / Magnitude : 5.5
Merkez / Epicenter : 42.4255 , 40.9522 derinlik / depth : 8.7 km
Tarih / Date : 20121226
Zaman / Time : 004431

Bu deprem icin otomatik olarak tahmin edilen siddet haritasi / Automatically generated analysis results for this event
http://www.kandilli.info/2012/12/26/004431/index.htm

Son yuz deprem icin liste / List of last 100 events:
http://www.kandilli.info

No Damage Estimation

Shakemap usc000ef8l

Instrumental Intensity Peak Ground Acceleration Peak Ground Velocity Uncertainty

Spectral Response 0.3 sec Period 1.0 sec Period 3.0 sec Period

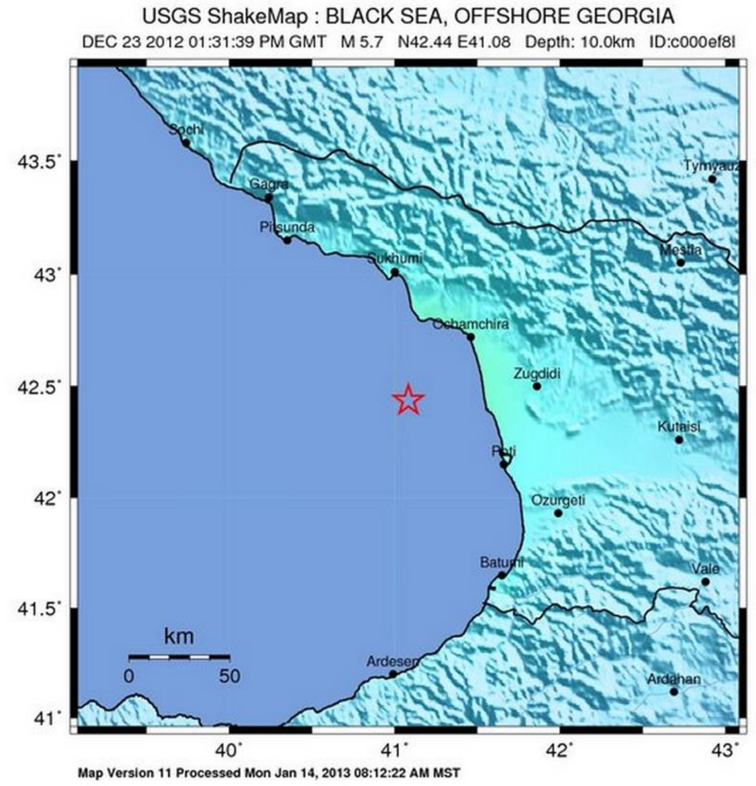
Media Maps

Decorated Bare

Downloads

Instrumental Intensity

Available Formats: JPG (97 kB) || PS (465 kB)



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.05	0.3	2.8	6.2	12	22	40	75	>139
PEAK VEL.(cm/s)	<0.02	0.1	1.4	4.7	9.6	20	41	86	>178
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

RT ELER was triggered by the following event

Magnitude : 6.1

Epicenter : 36.4715 , 28.8995 depth : 19.6 km

Date : 20120610, Time : 154416

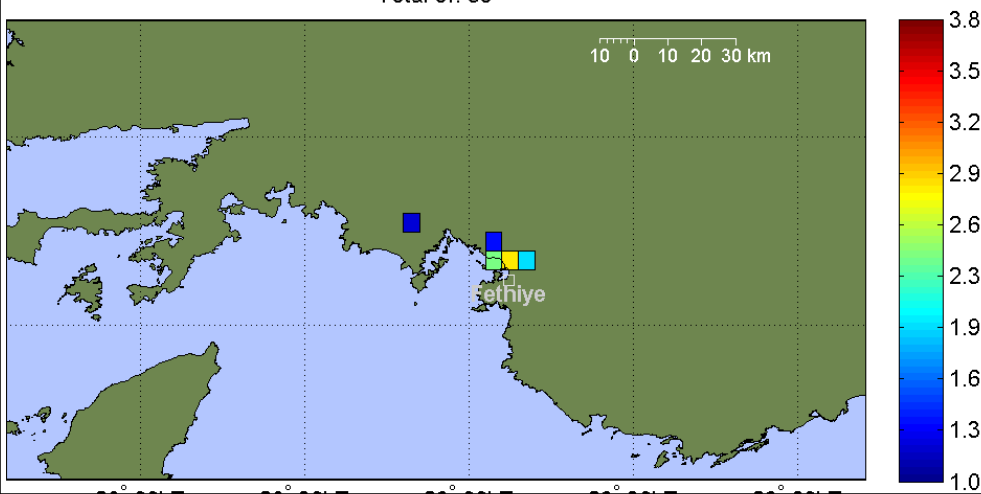
Automatically generated analysis results for this event

http://www.kandilli.info/2012/06/10/154416/index.htm

Damage Estimation Summary:

D5:0, D4:2, D3:39, D2:419, D1:3191

Distribution of Damaged Buildings [TOTAL] (D3)
Total of: 39



Shakemap usb000ac4h

Instrumental Intensity Peak Ground Acceleration Peak Ground Velocity Uncertainty

Spectral Response 0.3 sec Period

1.0 sec Period 3.0 sec Period

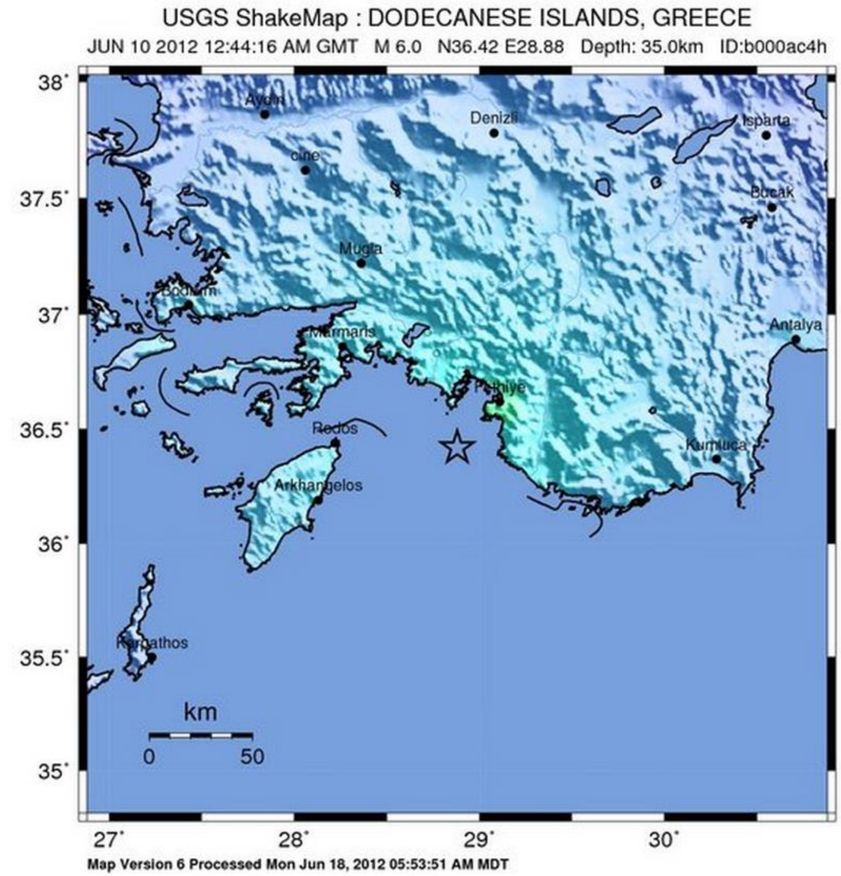
Media Maps

Decorated Bare

Downloads

Instrumental Intensity

Available Formats: JPG (98 kB) || PS (364 kB)

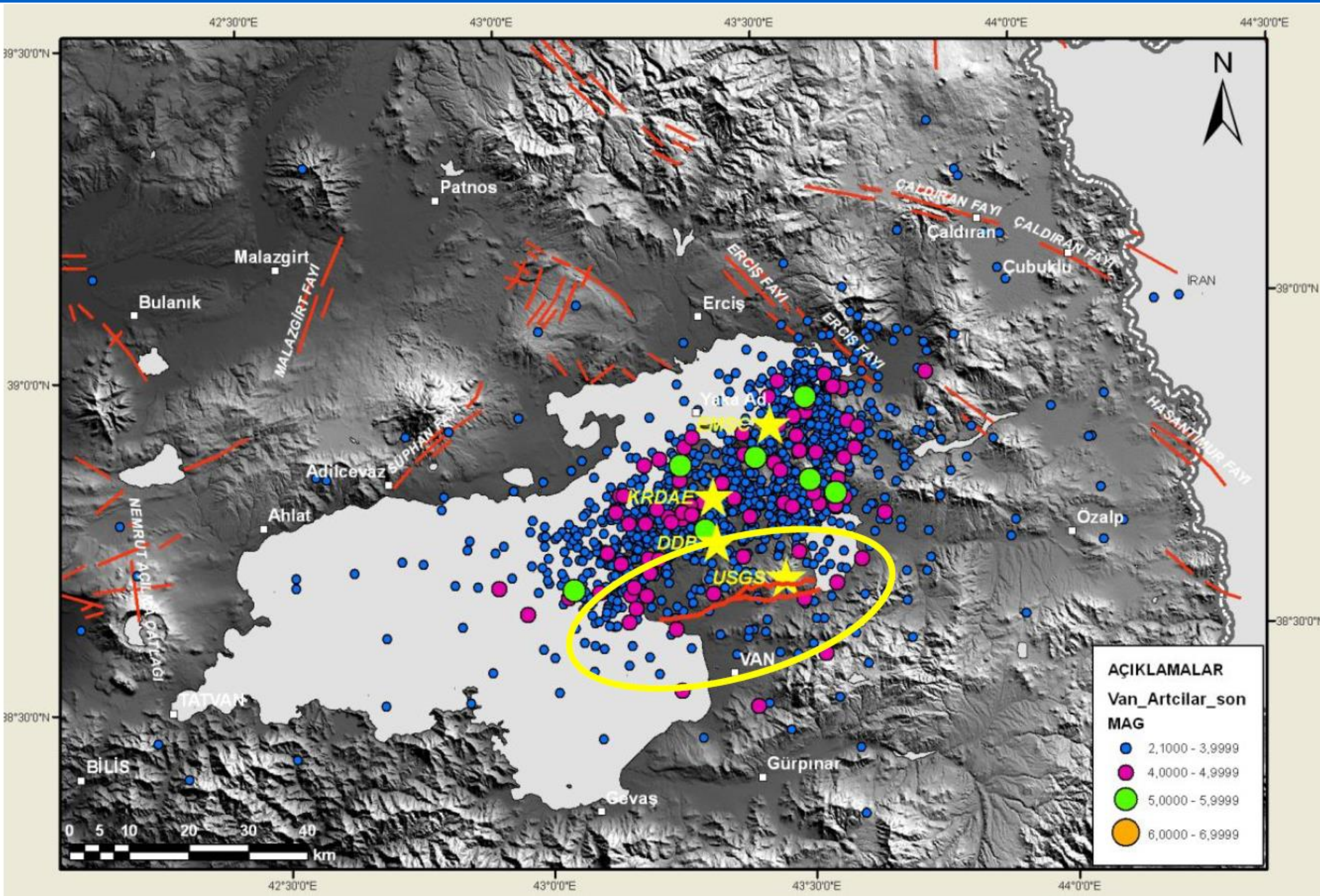


PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.05	0.3	2.8	6.2	12	22	40	75	>139
PEAK VEL.(cm/s)	<0.02	0.1	1.4	4.7	9.6	20	41	86	>178
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Performance of Rapid Earthquake Loss Estimation Systems

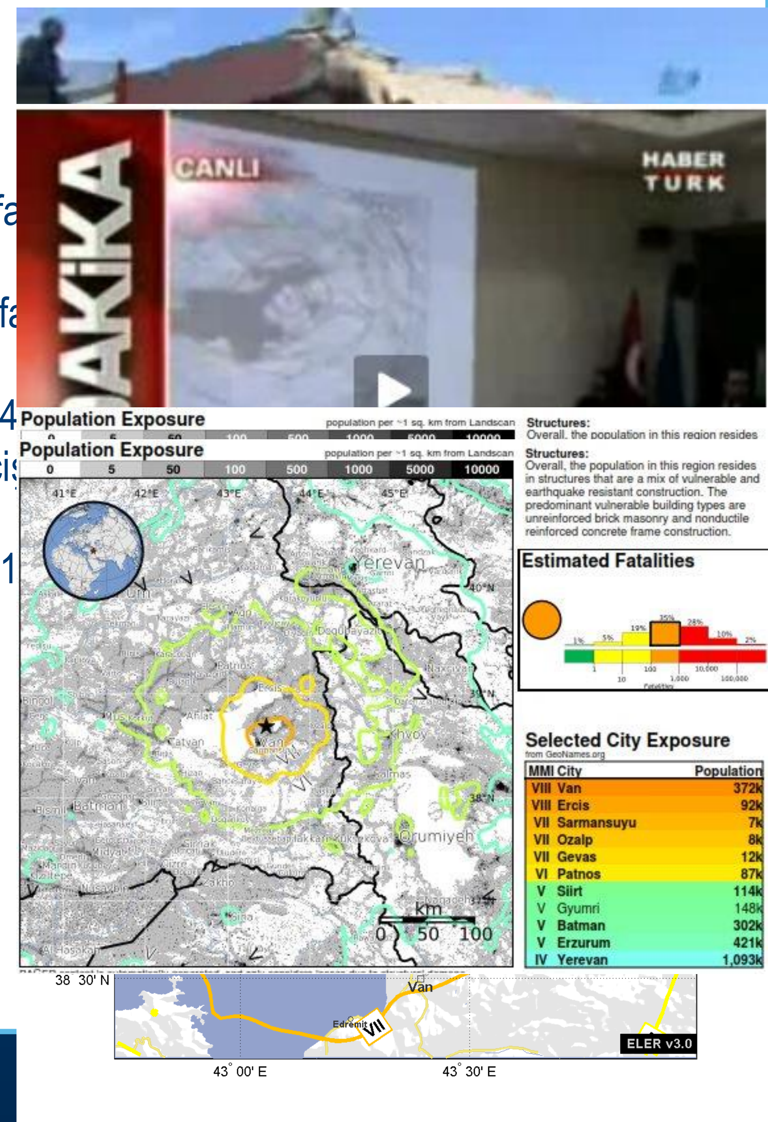
For rapid loss assessment after an earthquake the fast and reliable information on the source location and magnitude is essential. Most rapid loss basements (e.g.PAGER and QLARM) rely on teleseismic determinations of epicenters. This reliance can create error in loss estimations, especially in populated areas, since the mean errors in real-time teleseismic epicenter solutions, provided by U.S. Geological Survey (USGS, the PDE) and/or the European Mediterranean Seismological Center (EMSC), can be as large as 25 to 35km (Wyss et. al, 2011).

Oct. 23, 2011 Mw7.2 Van earthquake



Timeline of The Earthquake

00d:00h:00m : Earthquake, 23 October 2011 13:41
00d:00h:**05m** : Automatic SMS alarm sent ML 6.6, P waves reach Vienna
00d:00h:**08m** : Published on the web and Twitter, RT ELER triggered
00d:00h:**10m** : USGS announces Mw 7.6
00d:00h:**14m** : P waves reach Colorado,
00d:00h:**16m** : RT-ELER sends out first loss estimations with ML 6.6 (80 fa
00d:00h:**20m** : USGS revises to Mw 7.3
00d:00h:**27m** : First USGS PAGER loss estimations; red alarm 10k-100k fa
00d:00h:**30m** : First news reports of collapsed buildings
00d:00h:**43m** : RT-ELER updates results with Mw 7.3 (710 fatalities D5-D4
00d:**01h:20m** : First news reports of confirmed casualties (8 people in Ercis
00d:**01h:31m** : USGS PAGER Version 2; 10k-100k fatalities
00d:**02h:00m** : KOERI announces loss estimation on press conference: 71
01d:00h:00m : Official death toll: 217
01d:03h:31m : USGS PAGER Version 3; 1k-10k fatalities
01d:20h:00m : Official death toll: 432
04d:08h:00m : USGS PAGER Version 4; 100-1000 fatalities
05d:00h:00m : Official death toll: 550
12d:00h:00m : Final official death toll: 604

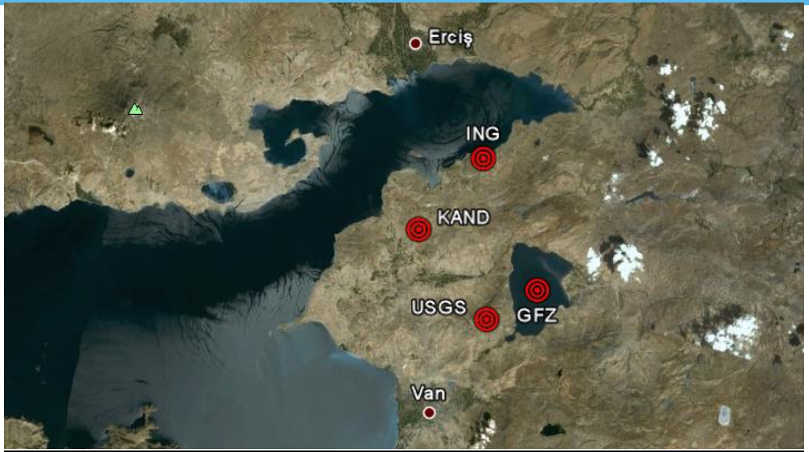


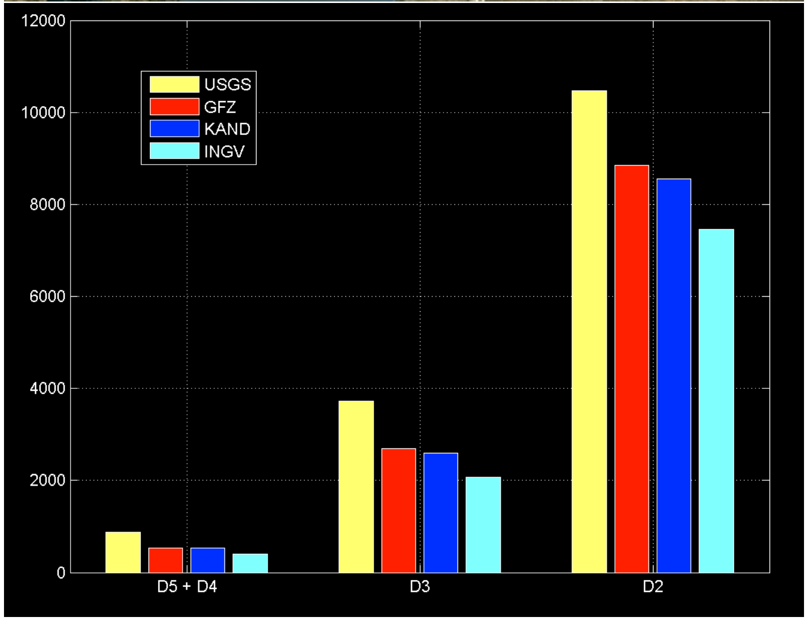
Different Epicenter locations

Different Epicenter locations

Inter-distance of 15-20km. Small?

In terms of loss estimations?

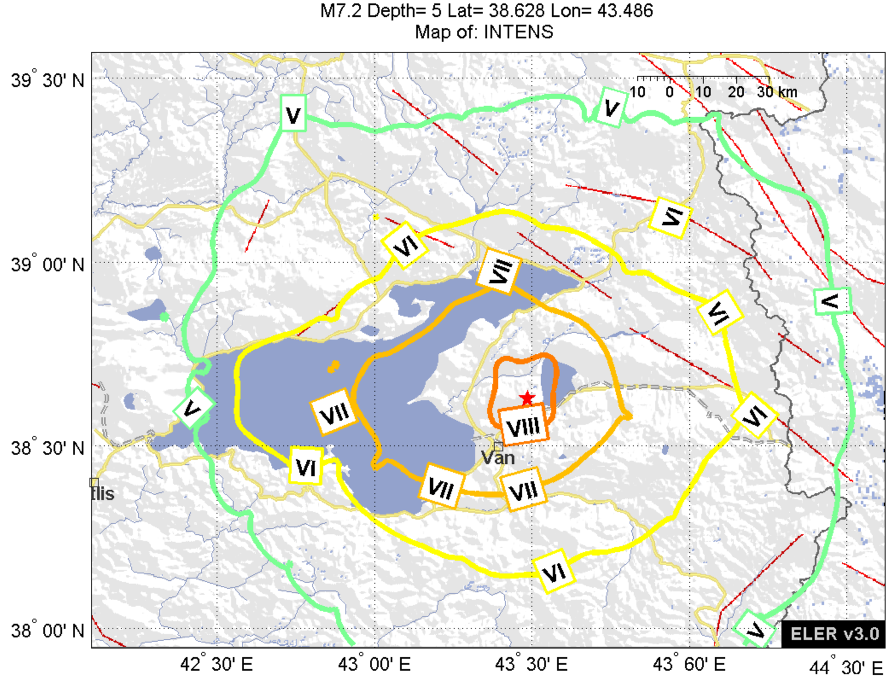


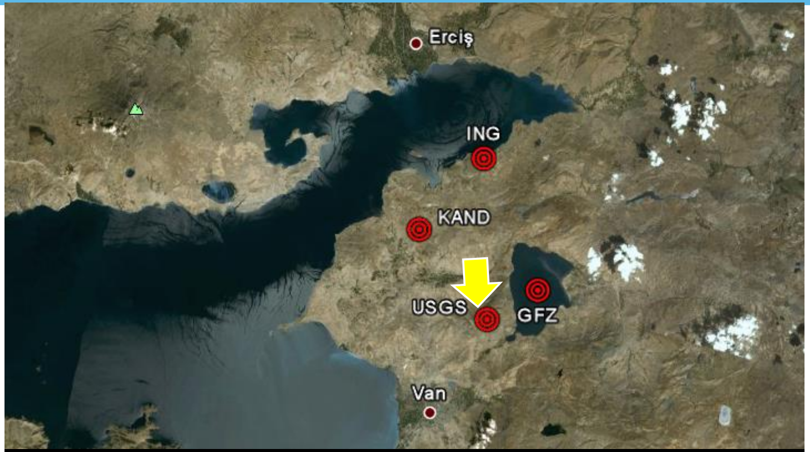


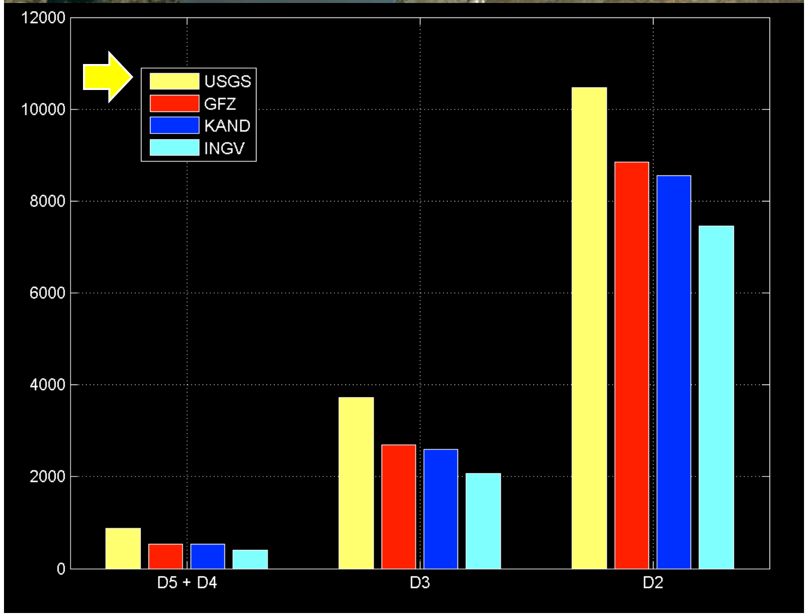
Different Epicenter locations

Inter-distance of 15-20km. Small?

In terms of loss estimations?



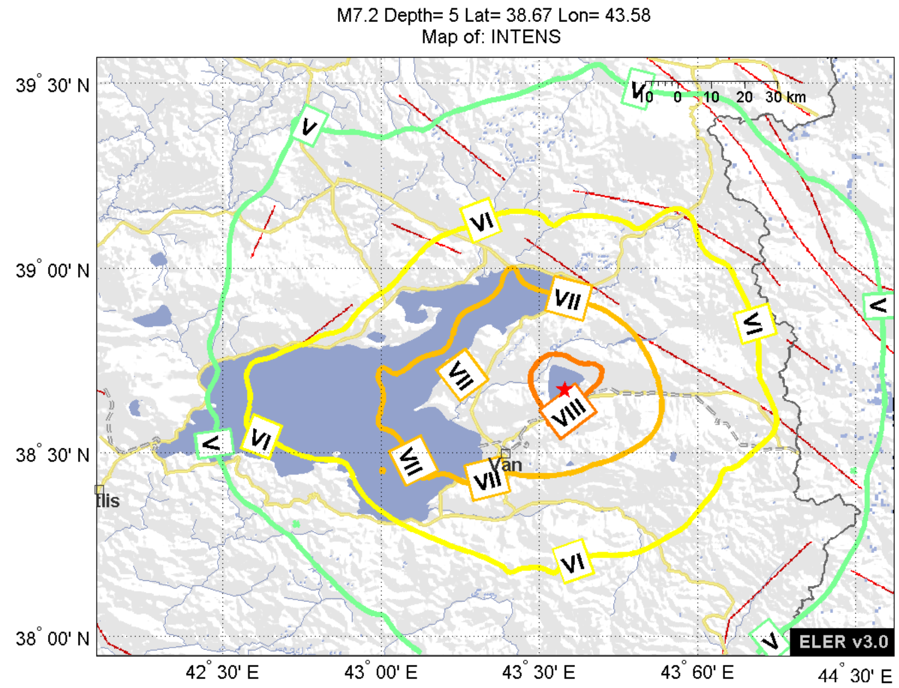


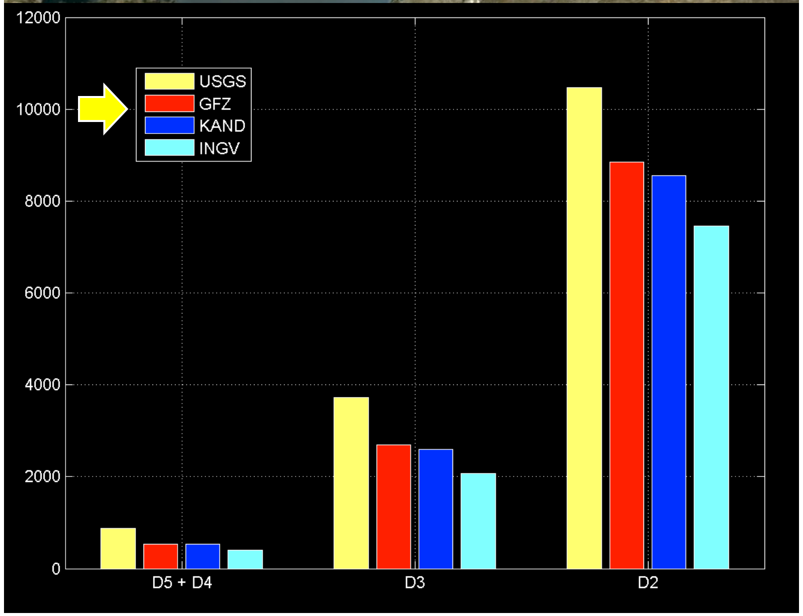


Different Epicenter locations

Inter-distance of 15-20km. Small?

In terms of loss estimations?

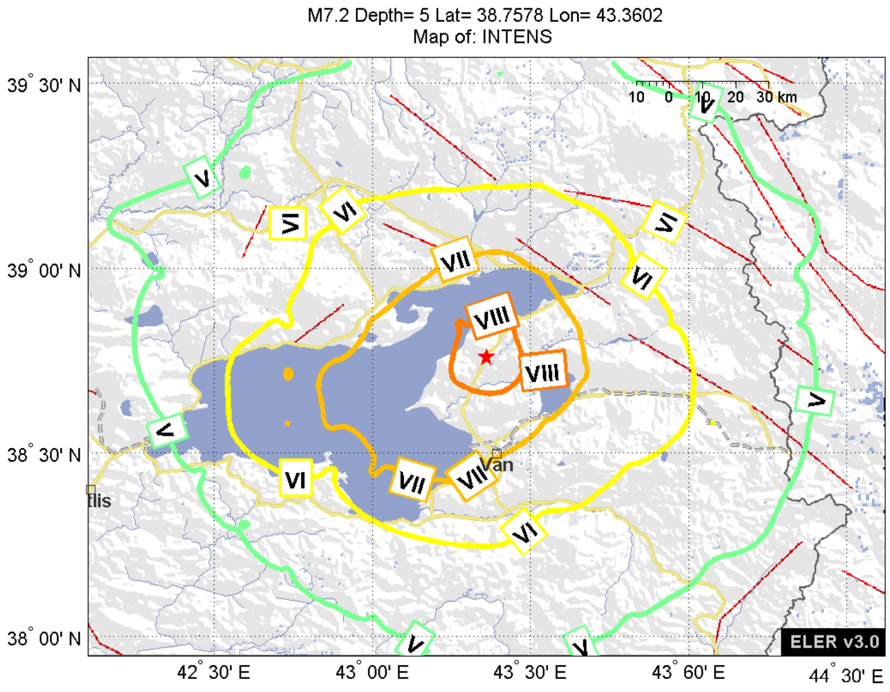


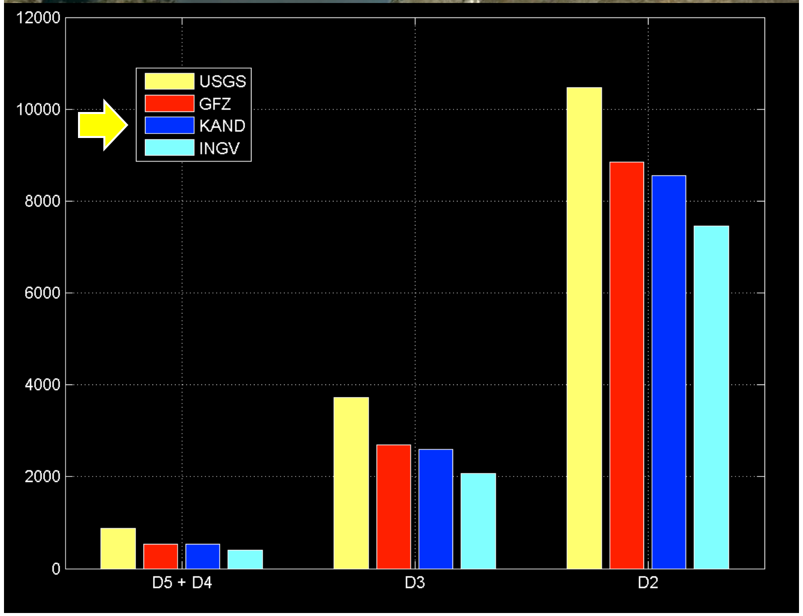


Different Epicenter locations

Inter-distance of 15-20km. Small?

In terms of loss estimations?

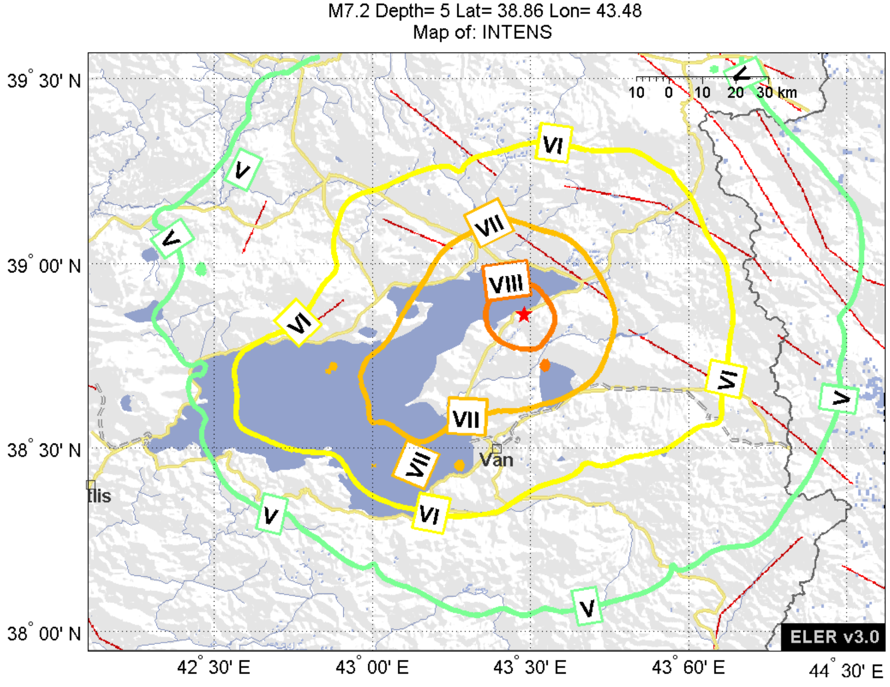


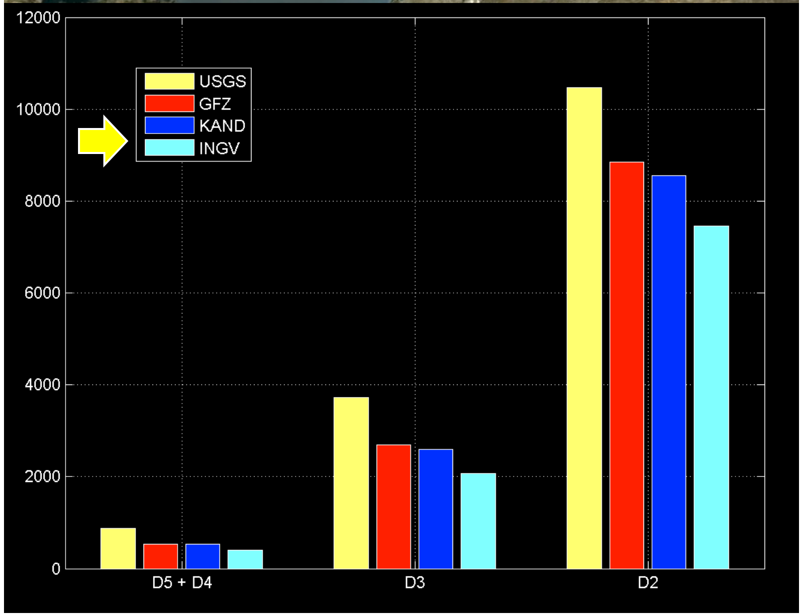


Different Epicenter locations

Inter-distance of 15-20km. Small?

In terms of loss estimations?

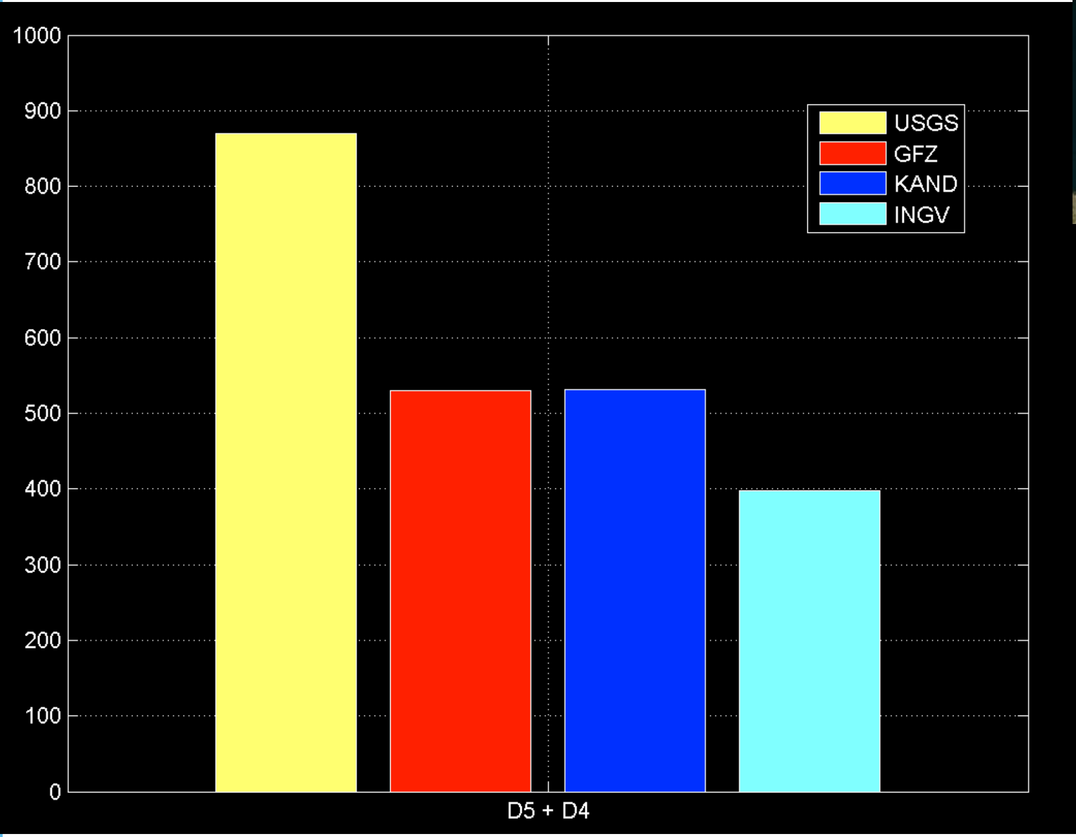


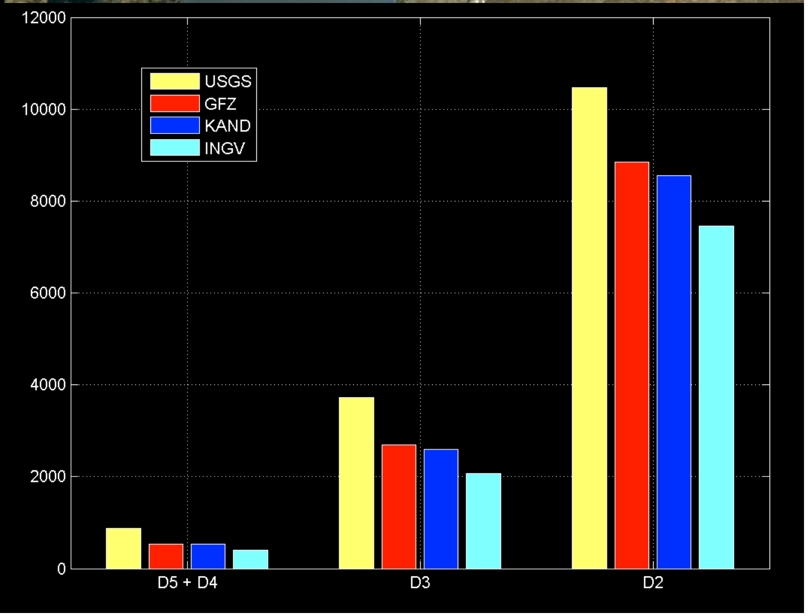


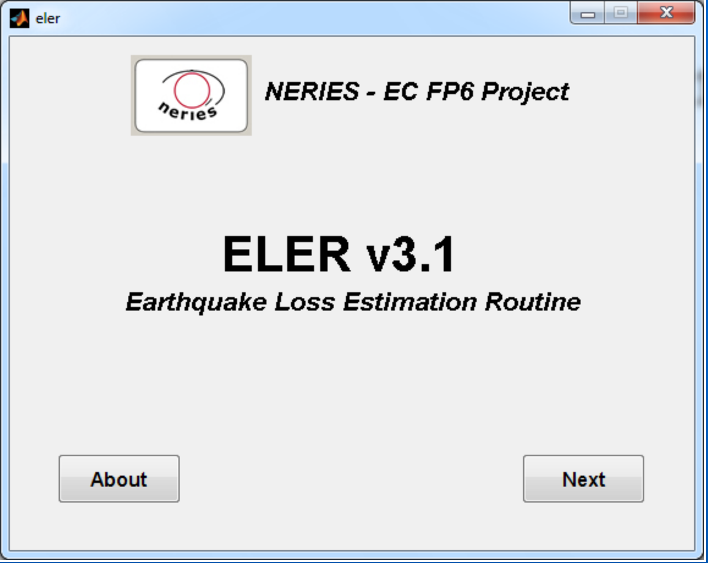
Different Epicenter locations

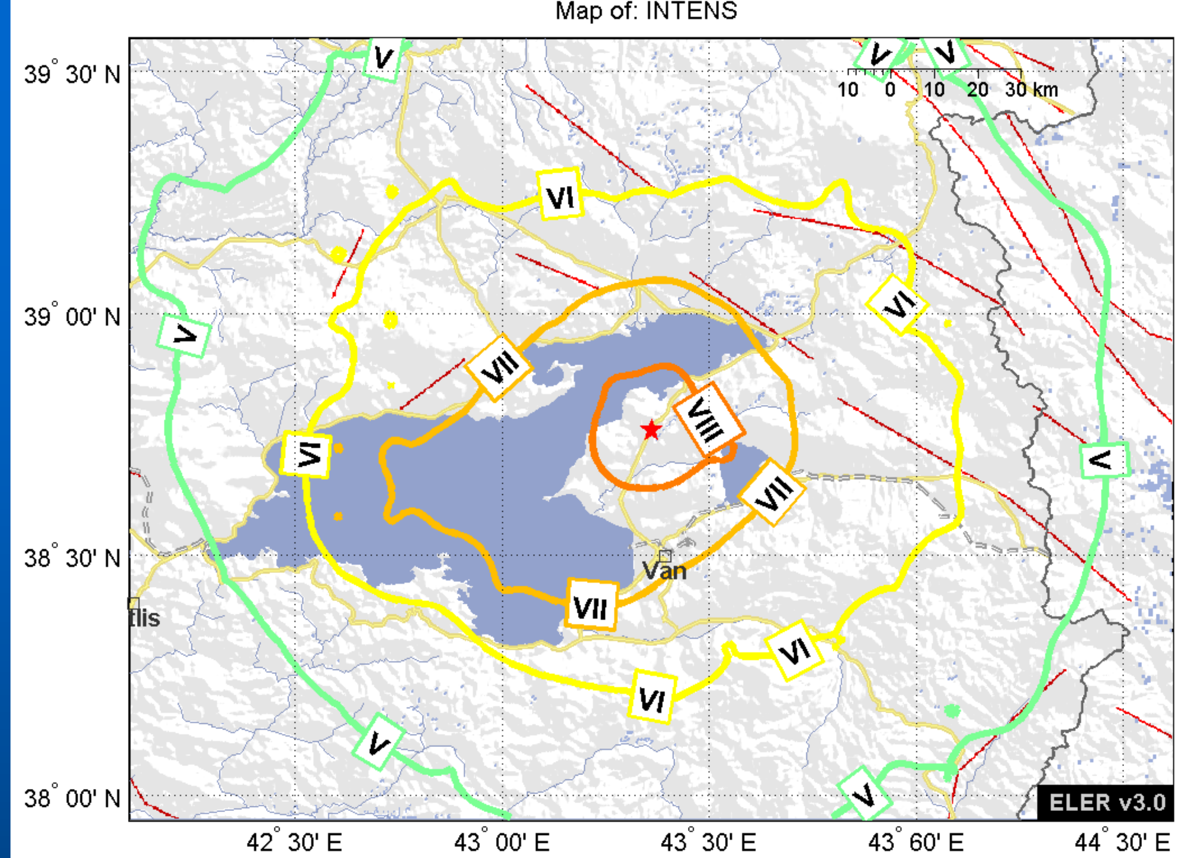
Inter-distance of 15-20km. Small?

In terms of loss estimations?







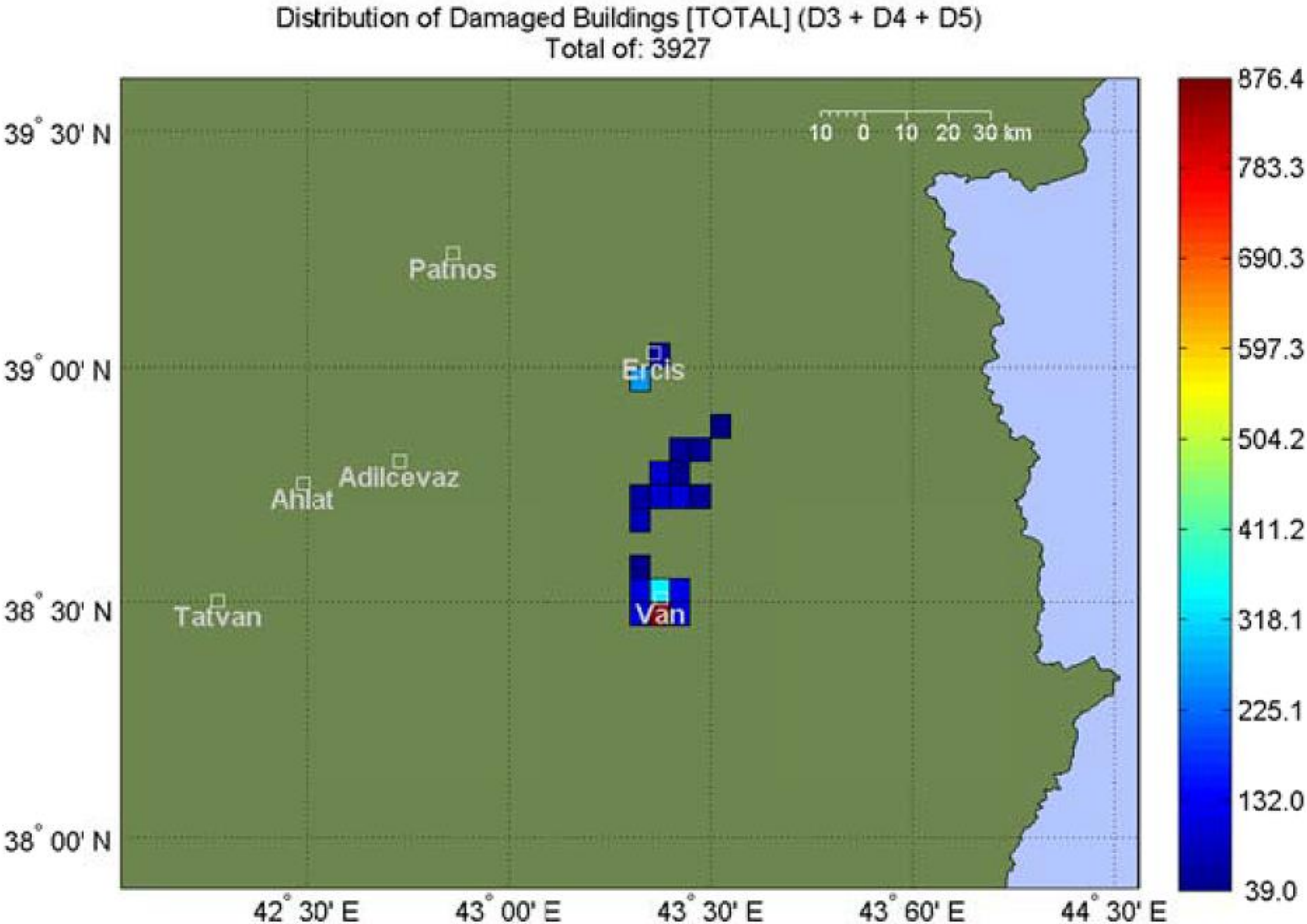


INTENSITY and DAMAGE MAPS (minutes after the earthquake)

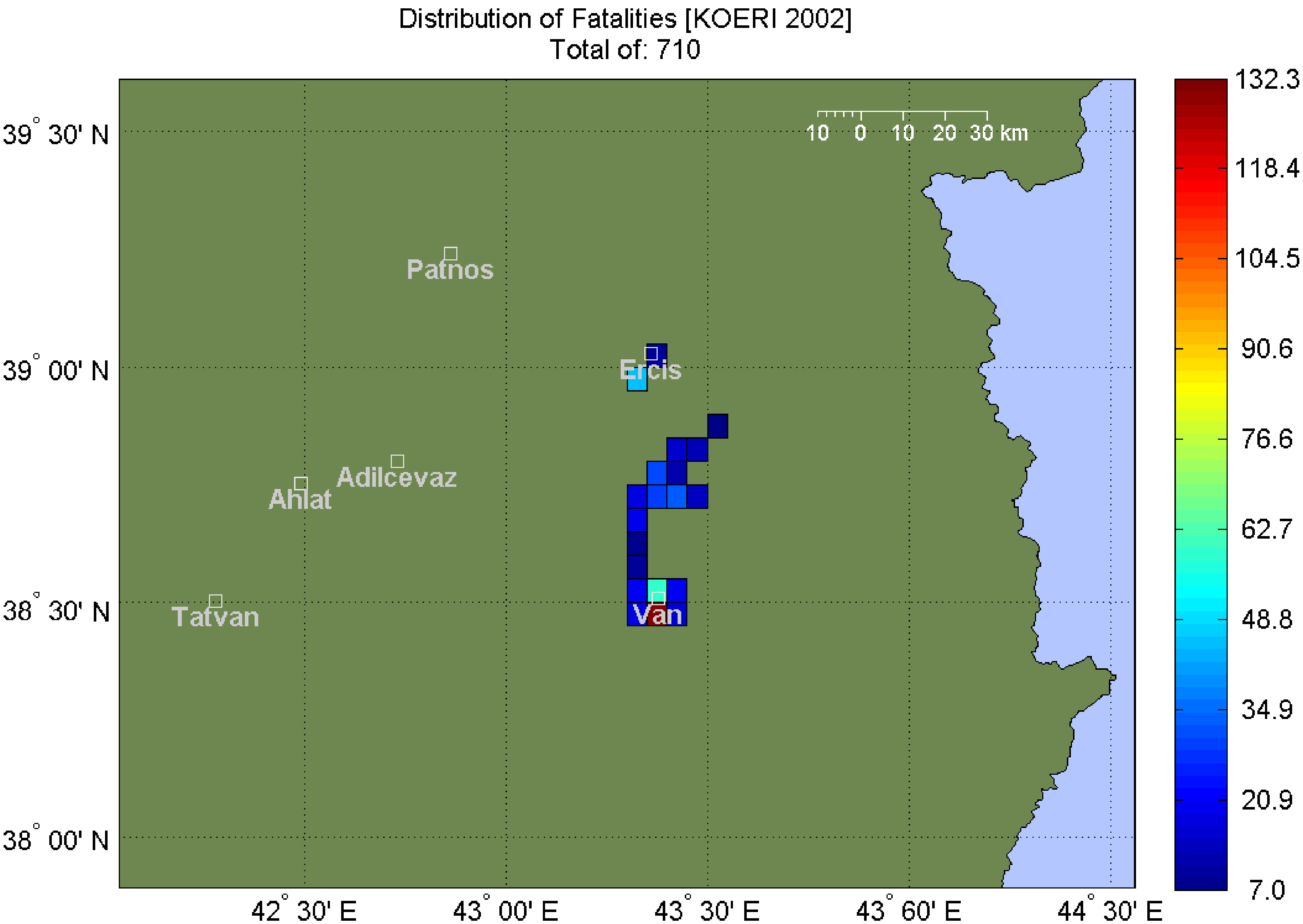
Distribution of Damaged Buildings [TOTAL] (D3 + D4 + D5)
Total of: 3927

Distribution of Fatalities [KOERI 2002]
Total of: 710

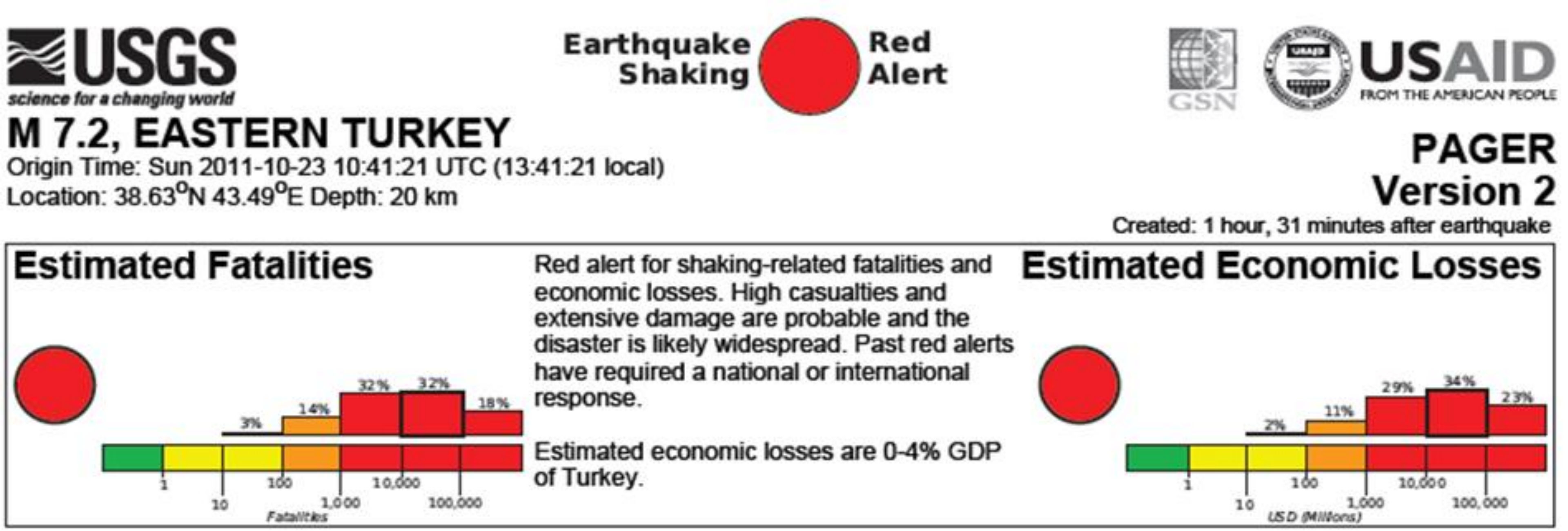
ABOUT 4500 BUILDINGS WITH MEDIUM to TOTAL DAMAGE
604 + 40 = 644 DEATHS

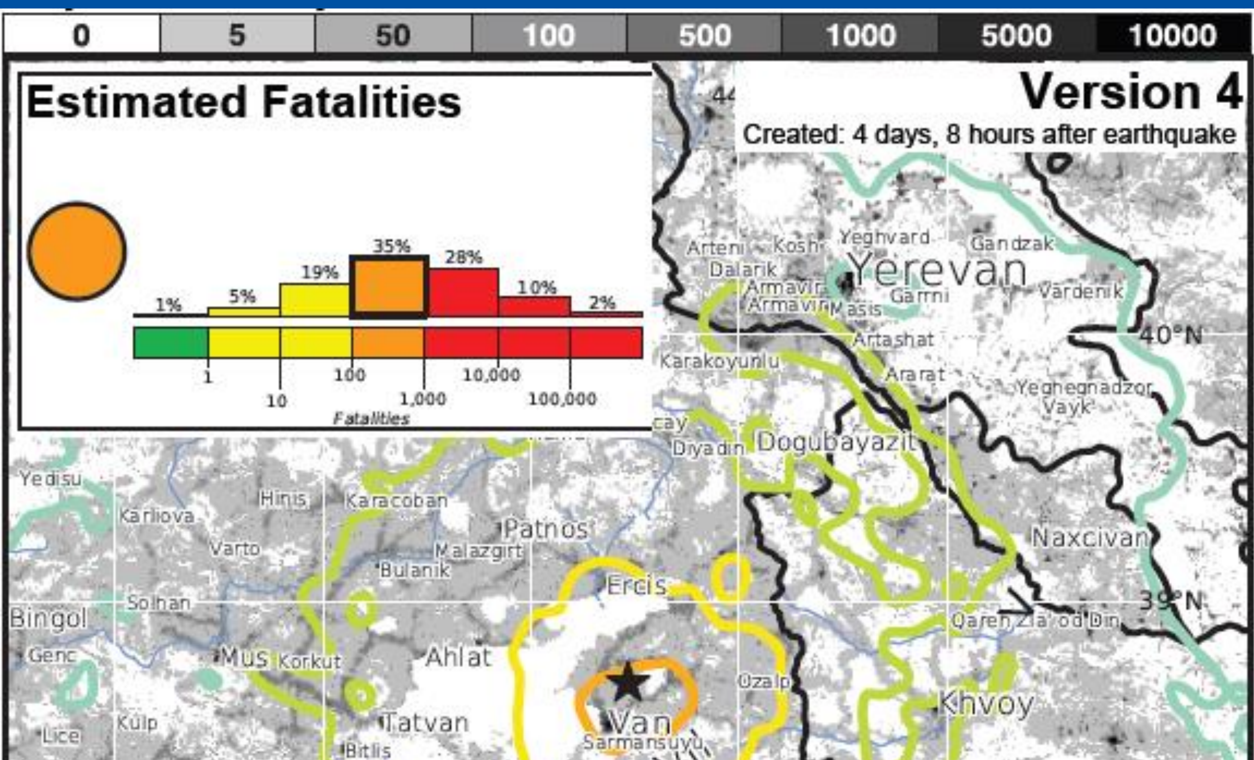


Distribution of Damaged Buildings [TOTAL] (D3 + D4 + D5)
Total of: 3927
39° 30' N
39° 00' N
38° 30' N
38° 00' N
42° 30' E
43° 00' E
43° 30' E
43° 60' E
44° 30' E
10 0 10 20 30 km
Patnos
Ercis
Adilcevaz
Ahlat
Tatvan
Van
876.4
783.3
690.3
597.3
504.2
411.2
318.1
225.1
132.0
39.0



Distribution of Fatalities [KOERI 2002]
Total of: 710
10 0 10 20 30 km
Patnos
Ercis
Adilcevaz
Ahlat
Tatvan
Van
39° 30' N
39° 00' N
38° 30' N
38° 00' N
42° 30' E
43° 00' E
43° 30' E
43° 60' E
44° 30' E
132.3
118.4
104.5
90.6
76.6
62.7
48.8
34.9
20.9
7.0





644 Fatalites

Economic loss
2 Bilion USD
(0.2% of GDP)

wapmerr@maxwyss.com to erdik

Earthquake Loss Estimate

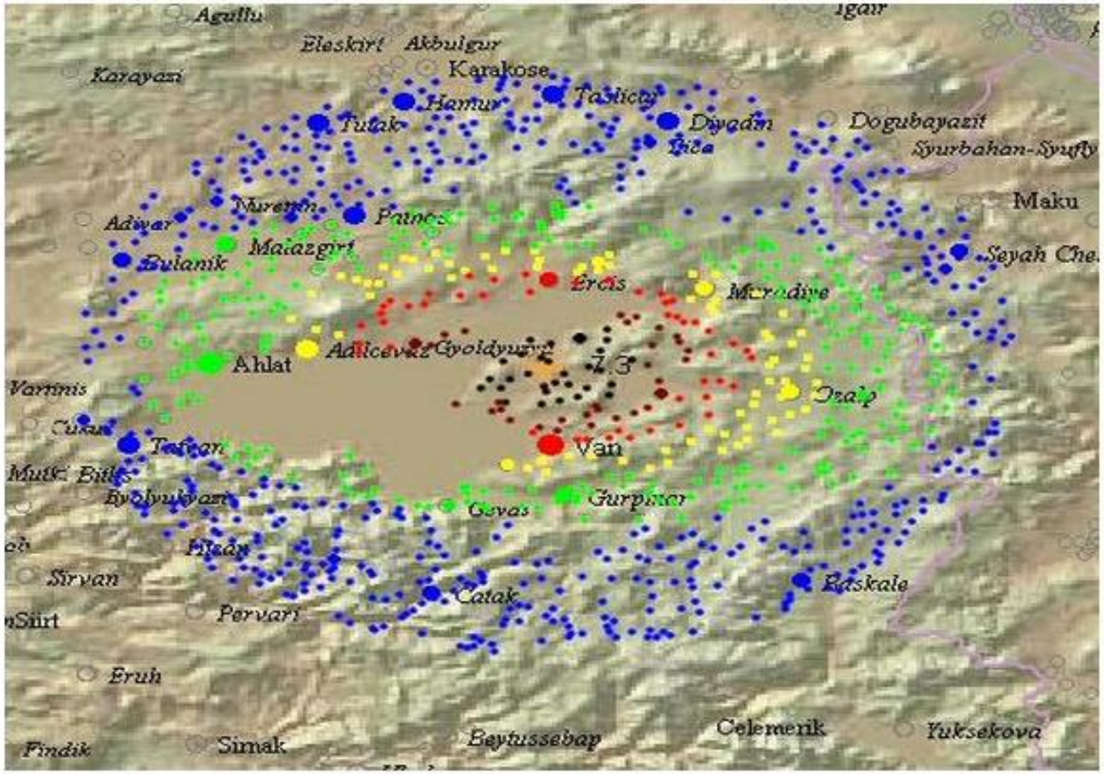
The following Earthquake has been Reported:

Date: 2011/10/23 10:41:23.0 6
Region: TURKEY
Latitude: 38.76 N
Longitude: 43.36 E
Magnitude: 7.3 M
Depth: 10 km
Source: ELER

ESTIMATE OF HUMAN LOSSES
Injured Exp. min/max: 20000/60000
Fatalities Exp. min/max: 8000/20000

ALERT LEVEL

MAP OF MEAN DAMAGE BY SETTLEMENT

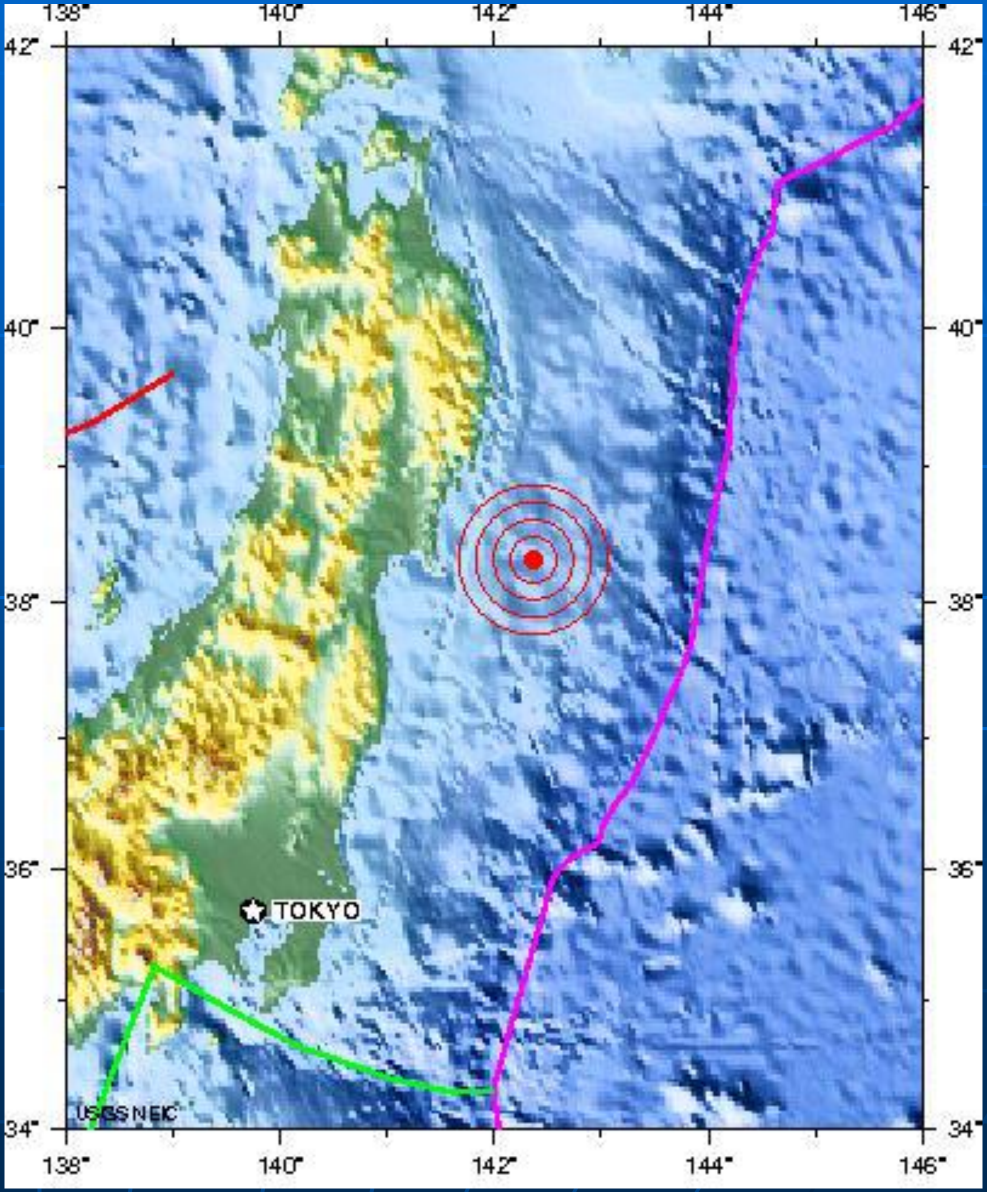


LEGEND

Epicenter
Damage and Population
mean Damage 0.01 - 0.5
mean Damage 0.5 - 1.5
mean Damage 1.5 - 2.5
mean Damage 2.5 - 3.5
mean Damage 3.5 - 4.5
mean Damage > 4.5
Population 1 - 3,000
Population 3,000 - 30,000
Population 30,000 - 300,000
Population 300,000 - 3. Mil.
Population > 3 Mil.

Magnitude 9.0 NEAR THE EAST COAST OF HONSHU, JAPAN
Friday, March 11, 2011 at 05:46:23 UTC

This earthquake occurred 130 km (80 miles) east of Sendai, Honshu, Japan and 373 km (231 miles) northeast of Tokyo, Japan.



Earthquake off Honshu Inbox x

wapmerr@maxwyss.com author@maxwyss.com 3/11/11

to undisclosed recipients

The Following Earthquake has been Reported:

Date: 2011/03/11 05:46:22.0
Region: Near east coast of eastern Honshu, Japan
Magnitude: M 8.5
Latitude: 38.31 N
Longitude: 142.52 E
Depth (km): 10.0
Source: NEI
Injured Exp. min/max: 0 / 200
Fatalities Exp. min/max: 0 / 1000

The magnitude estimates range from 7.9 to 8.5 at the moment. However, the epicenter is 100 km offshore. nevertheless, some casualties may be expected. Maximum Intensity is expected to be VII.

wapmerr@maxwyss.com author@maxwyss.com 3/11/11

to undisclosed recipients

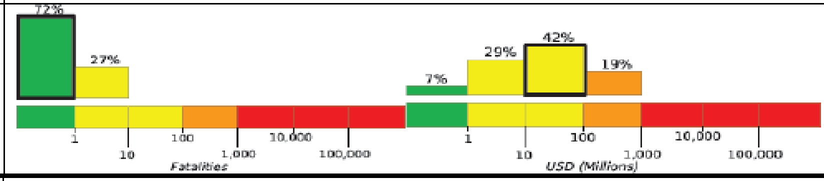
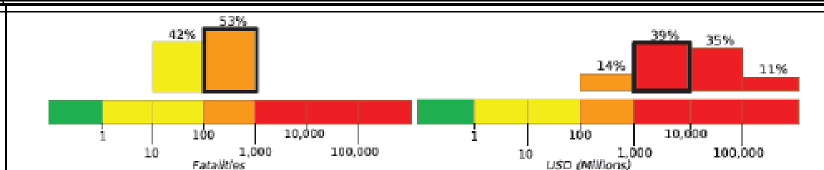
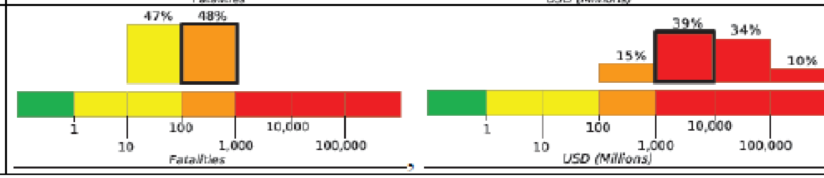
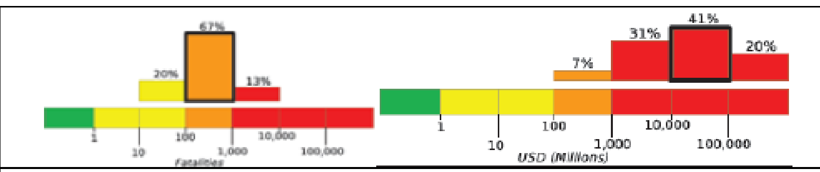
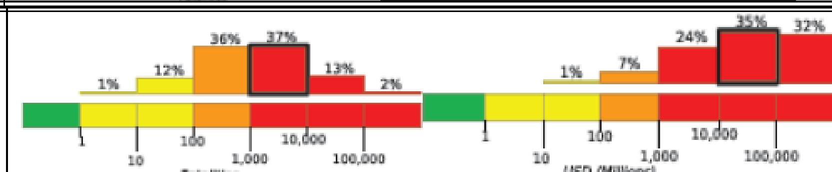
SECOND MESSAGE
The Following Earthquake has been Reported:

Date: 2011/03/11 05:46:22.0
Region: Near east coast of eastern Honshu, Japan
Magnitude: M 8.5
Latitude: 38.31 N
Longitude: 142.52 E

The magnitude I have used in my previous message was from GFZ M8.5
Tsunami warning center gives M7.9
NEIC of the USGS estimates M7.9

Because of the large dimensions of this rupture part of the energy could have been released closer to shore than 100 km. Thus, the human losses are difficult to estimate.

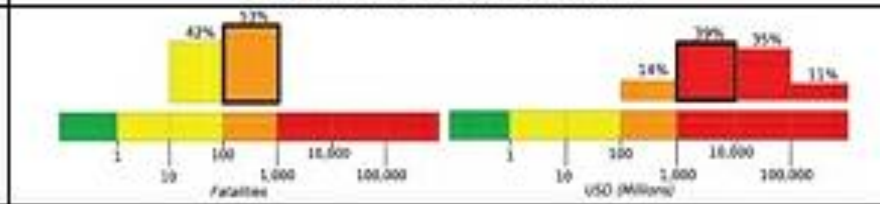
Socio-economic loss estimates for the 2011 Tohoku EQ.

Software	Time since event	Magnitude	Estimate NB: PAGER = Shaking losses only to structures.
USGS PAGER v1	22min 58sec	Mw7.9	
WAPMERR QLARM	similar	Mw8.5	0-1000 fatalities, 0-200 injuries
USGS PAGER v3	75min	Mw8.9	
USGS PAGER v5	2hrs44min-2hrs47min	Mw8.9	
USGS PAGER v6	3 days, 16hrs	Mw9.0	
USGS PAGER v12	15 days	Mw9.0	
Japanese Cabinet Office	3 months	Mw9.0	Direct: 16.4 trillion JPY ($208 billion) for the 4 largest prefectures (8.4 trillion JPY Infrastructure, 2.4 trillion JPY Homes, 1.6 trillion JPY Manufacturing, 4.0 trillion JPY Other)

Casualty range loss estimates from selected casualty models for the 2011 Tohoku EQ for earthquake shaking deaths *(Daniell et al, 2011)*

Casualty Model	Lower	Median*	Upper
Kawasumi (1954)	2187	3410	5567
Tokyo Metropolitan Government (1978)	1716	2334	3132
Saitama Prefecture (1982)	35	39	43
Ohta et al. (1983)	210	288	409
Tokyo Metropolitan Government (1985)	229	291	360
Gotoh and Ohta (1985)	95	120	156
Osaka City Method	781	1098	1601
Ikeda and Nakabayashi (1996)	729	1026	1496
Ye and Okada (2001)	104	163	244
USGS PAGER v12	100	1030	10000
WAPMERR QLARM	0	Unk.	1000

15815 have been killed and 3966 are missing (19781 in total). Around 230 should be earthquake-collapse related. Around 250 could be related to other causes such as fire, landslides etc. Around 94% of deaths are tsunami related.

USGS PAGER v3 **Fatality = 100-1000 1-10 Billion USD**	75min	Mw8.9	

PAGER - M 9.0 - NEAR THE EAST COAST OF HONSHU, JAPAN

Alert level does not include impacts from earthquake-related hazards such as tsunamis, landslides, fires or liquefaction.

Earthquake Shaking Alert Level: RED Download Alert PDF What's this?

Friday, March 11th, 2011 at 05:46:24 UTC (14:46:24 local)

Location: 38.3° N, 142.4° E Depth: 29km

Event Id: USC0001XGP

Alert Version: 15

Created: 22 weeks, 6 days after earthquake.

FOR TSUNAMI INFORMATION, SEE: tsunami.noaa.gov.

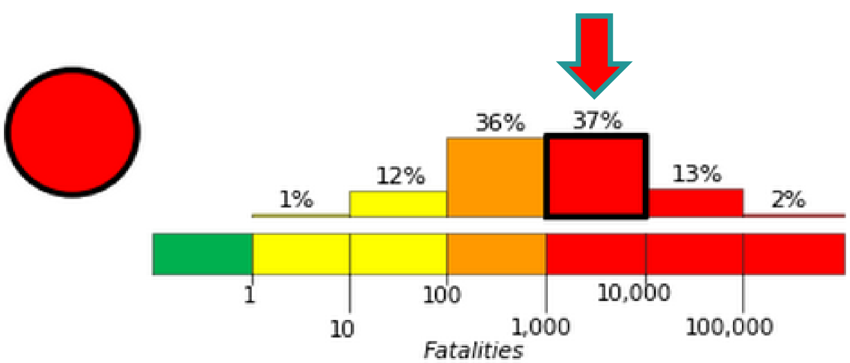
Actual Fatalites = 20,000 (230 due to shaking)
Actual Economic Loss = 200 Billion USD

Alert Information

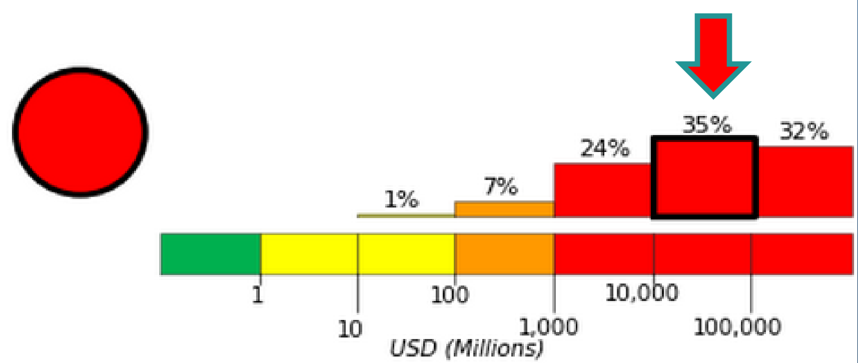
Red alert for shaking-related fatalities and economic losses. High casualties and extensive damage are probable and the disaster is likely widespread. Past red alerts have required a national or international response. Estimated economic losses are 0-1% GDP of Japan.

Show graphs as tables

Estimated Fatalities



Estimated Economic Losses



Uncertainties in real-time estimates of human losses are a factor of two, at best. And the size of the most serious errors can be an order of magnitude.
They can be generated by hypocenter errors, incorrect data on building stock, and magnitude errors, especially for large earthquakes.

The reduction of the uncertainties inherent in the basic ingredients of earthquake loss assessment is an important issue that needs to be tackled in the future for viability and reliability of rapid loss assessments.
Improvement in the speed and quality of moment tensor information, including estimates of rupture direction and fault finiteness, will be needed for refining loss estimates especially in regions without dense local seismograph networks.

It is believed that the increasing number of scientific studies, outcomes of the relevant EU projects (such as NERIES, SAFER, NERA and REAKT), ongoing refinements in PAGER methodologies, as well as the expected achievements of the Global Earthquake Model project will provide the correct directions and developments in this regard.


THANK YOU