Estimating the Extent of Disaster in Earthquakes

Max Wyss

World Agency for Planetary Monitoring and Earthquake Risk Reduction

Nonprofit Organization

www.wapmerr.org

Losses

Building damage

Number of fatalities

Number of injured

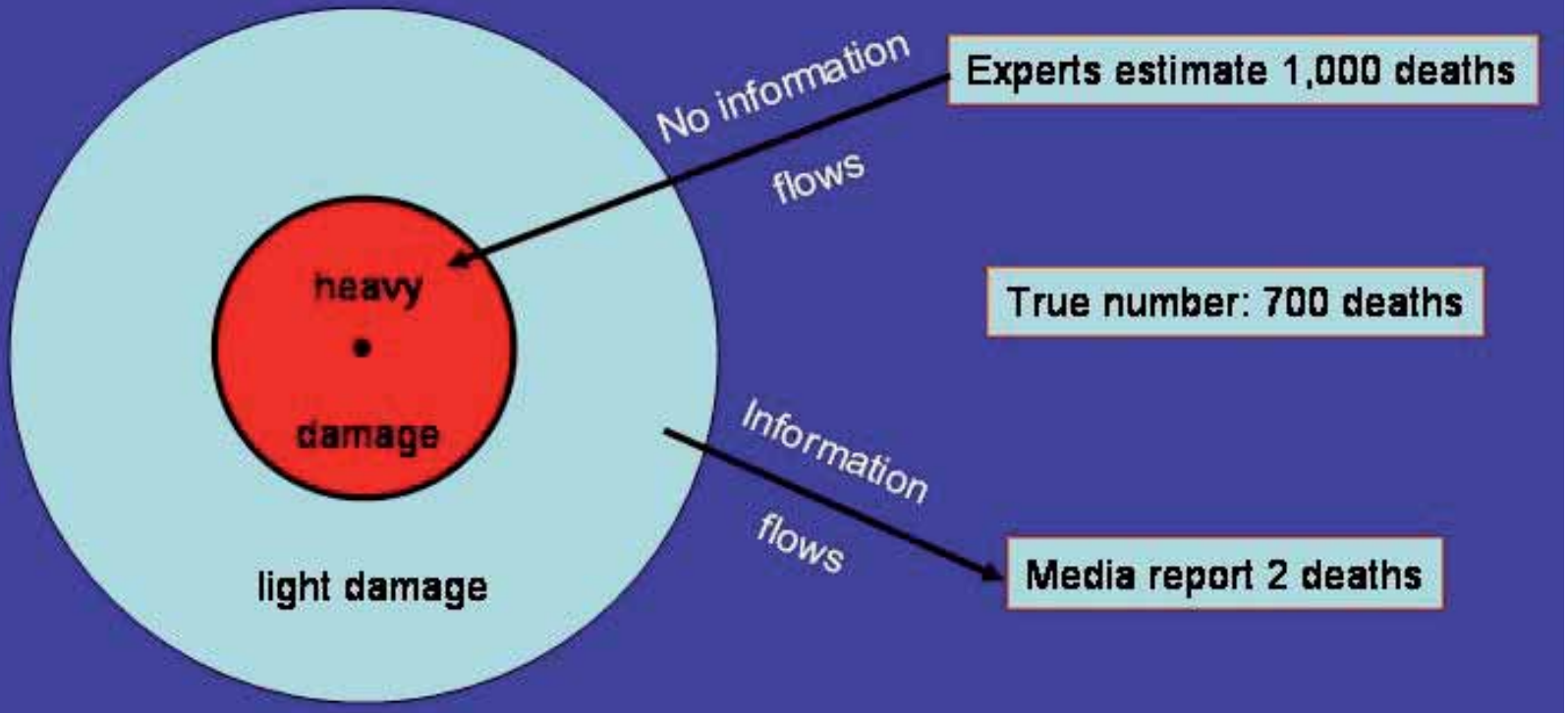
Input needed

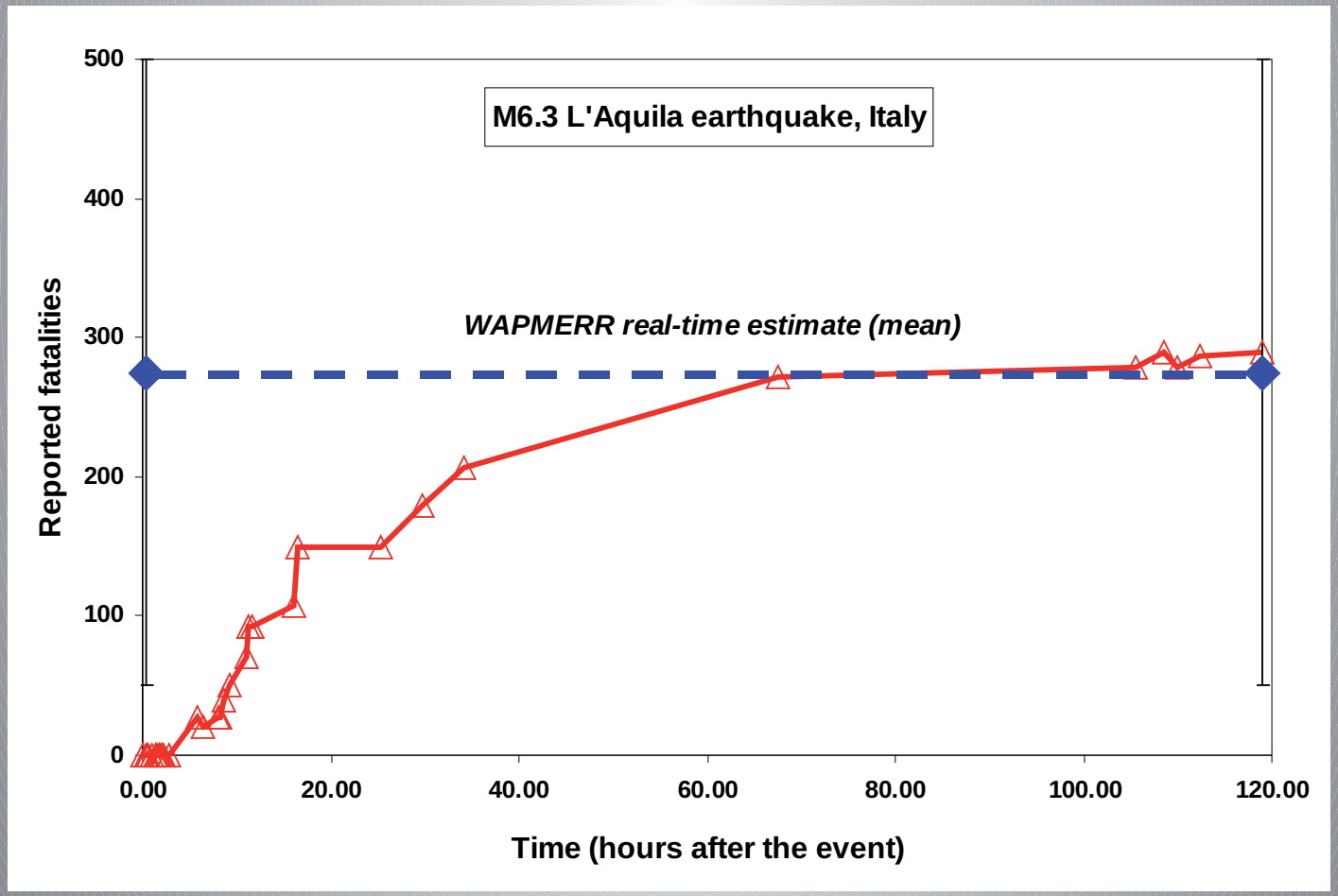
Location of earthquake

Population numbers

Building fragility

Why estimate losses immediately after earthquakes?



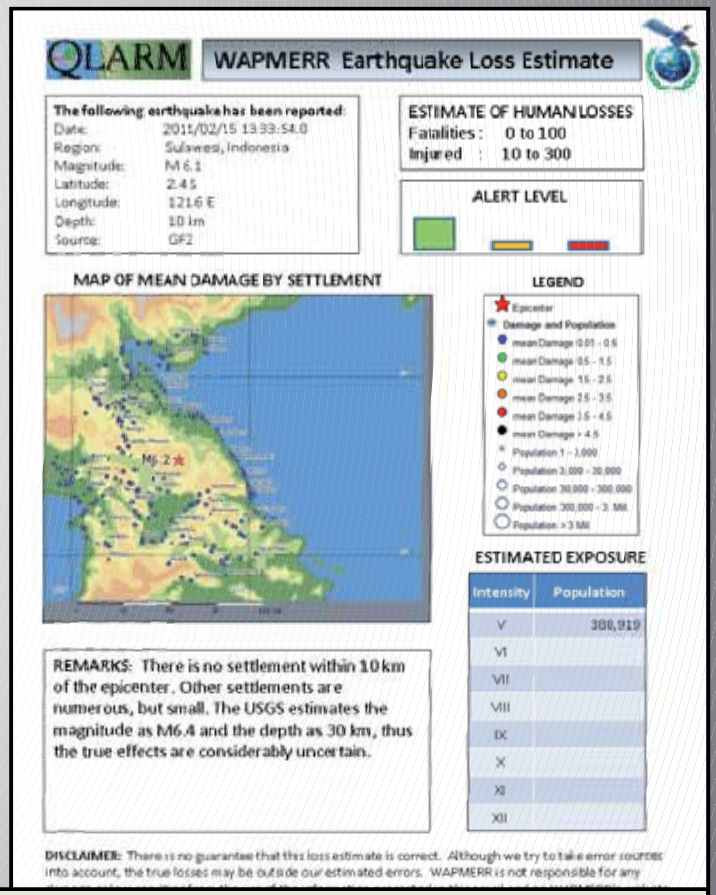


Reported fatalities due to the L'Aquila earthquake of 6 April 2009 (triangles) as a function of time after the earthquake, compared to the quantitative estimate by WAPMERR, based on M6.3, 22 minutes after the occurrence time (diamond with error bars).

Prediction of losses immediately after an earthquake

QLARM output for the affected region

Standard email message



QLARM WAPMERR Earthquake Loss Estimate

The following earthquake has been reported:
Date: 2011/02/15 13:33:54.0
Region: Sulawesi, Indonesia
Magnitude: M 6.1
Latitude: 2.4 S
Longitude: 121.6 E
Depth: 10 km
Source: GFZ

ESTIMATE OF HUMAN LOSSES
Fatalities: 0 to 100
Injured : 10 to 300

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 - 1,000
Population 1,000 - 10,000
Population 10,000 - 100,000
Population 100,000 - 1 Mill.
Population > 1 Mill.

ESTIMATED EXPOSURE

Intensity	Population
V	308,919
VI	
VII	
VIII	
IX	
X	
XI	
XII	

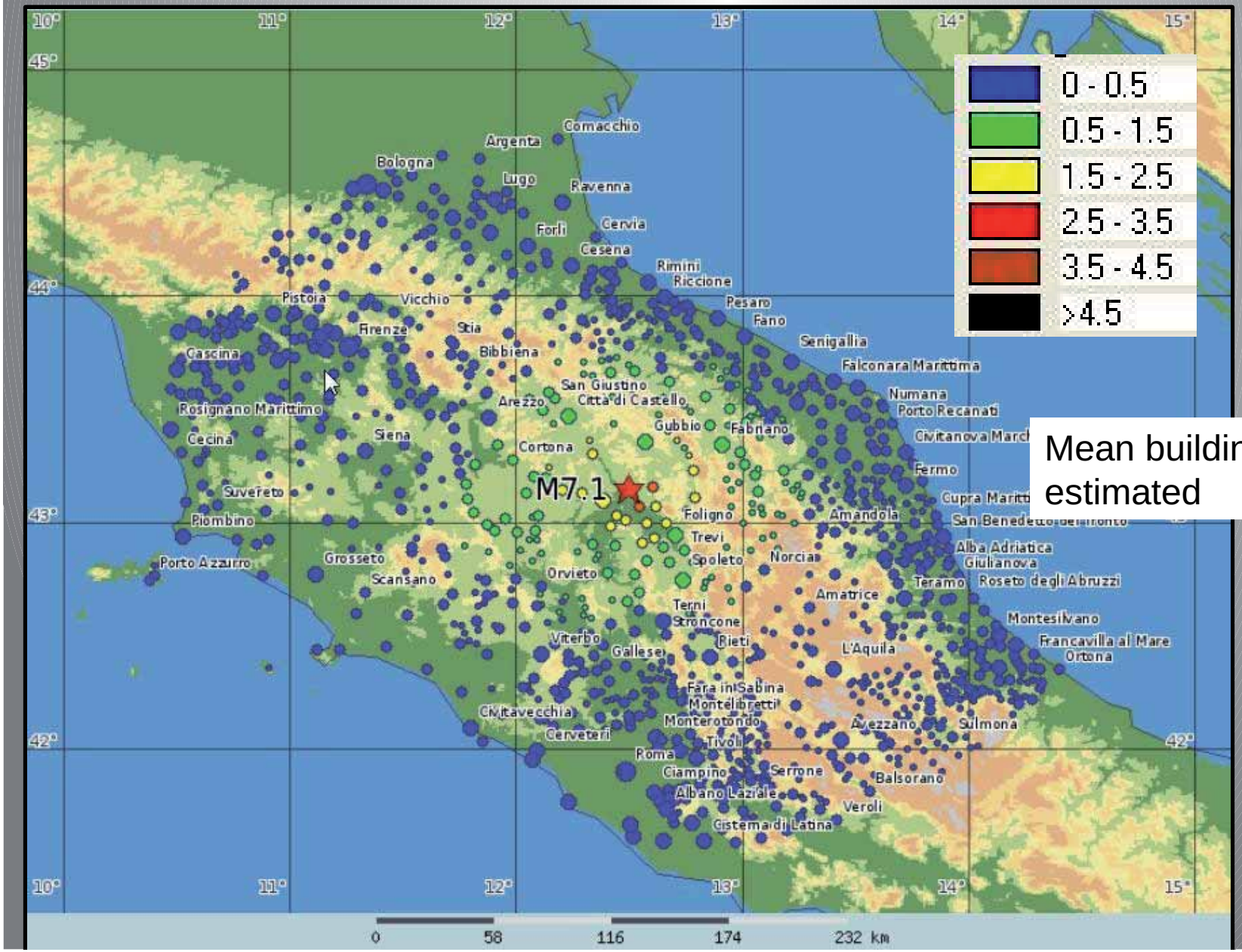
REMARKS: There is no settlement within 10 km of the epicenter. Other settlements are numerous, but small. The USGS estimates the magnitude as M6.4 and the depth as 30 km, thus the true effects are considerably uncertain.

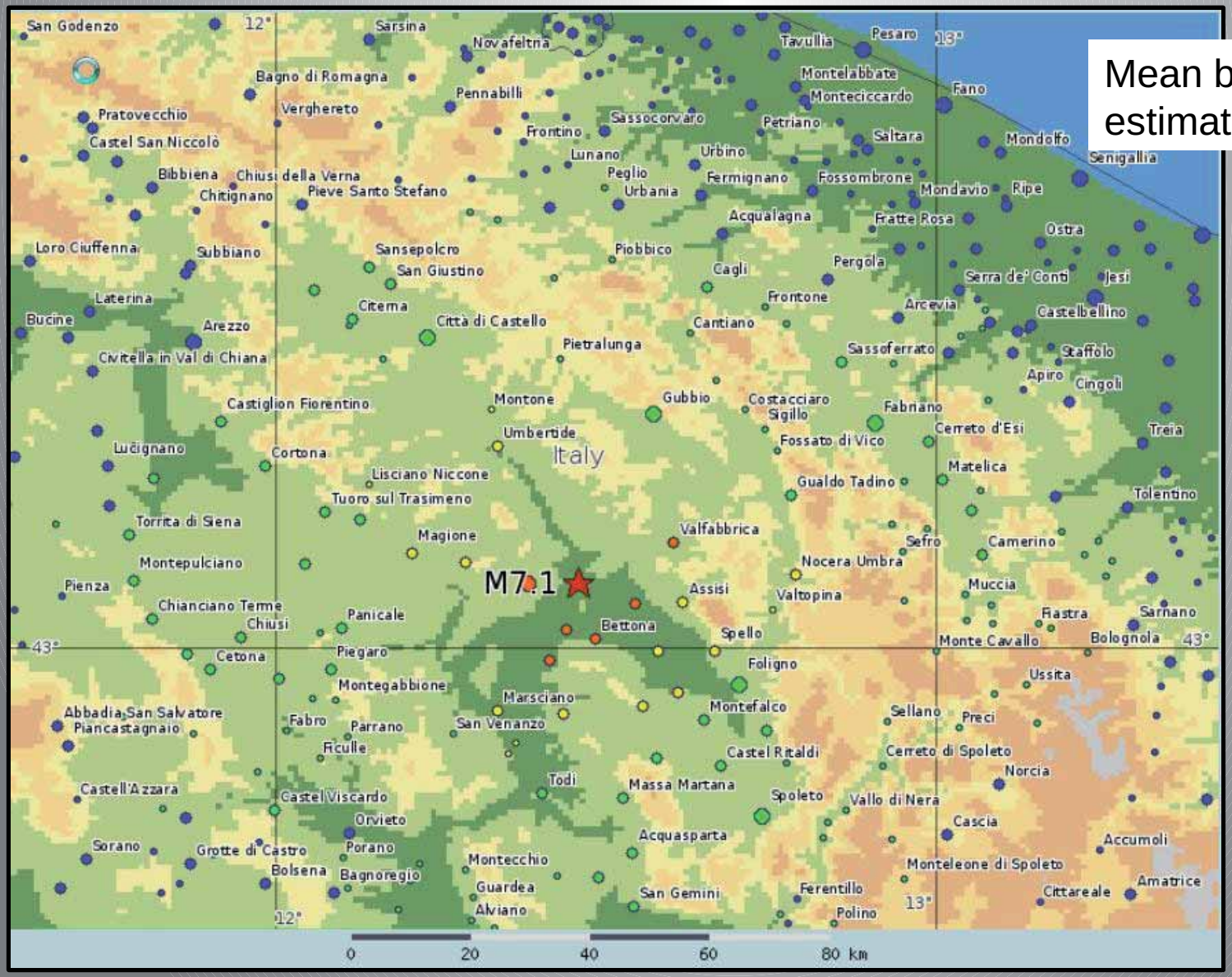
DISCLAIMER: There is no guarantee that this loss estimate is correct. Although we try to take error sources into account, the true losses may be outside our estimated errors. WAPMERR is not responsible for any

Details available on request

	population	distance	intensity	buildings no damage	buildings slight damage	buildings moderate damage	buildings heavy damage	buildings very heavy damage non collapse	buildings very heavy damage collapse	fatalities (min)	fatalities (max)	patients (min)	patients (max)	mean damage grade
	1000 Pers.	km	-	%	%	%	%	%	%	Pers.	Pers.	Pers.	Pers.	-
L'Aquila	71.6	2	8	7.4	22.9	31.6	25.9	6.2	6.0	117	265	861	1,769	2.2
Roma	2,874.2	90	4	96.6	3.0	0.4	0.0	0.0	0.0	0	0	31	56	0.0
Tornimparte	3.1	9	8	12.1	28.5	30.9	20.2	4.6	3.8	6	12	26	51	1.9

Prediction of losses for a future hypothetical earthquake

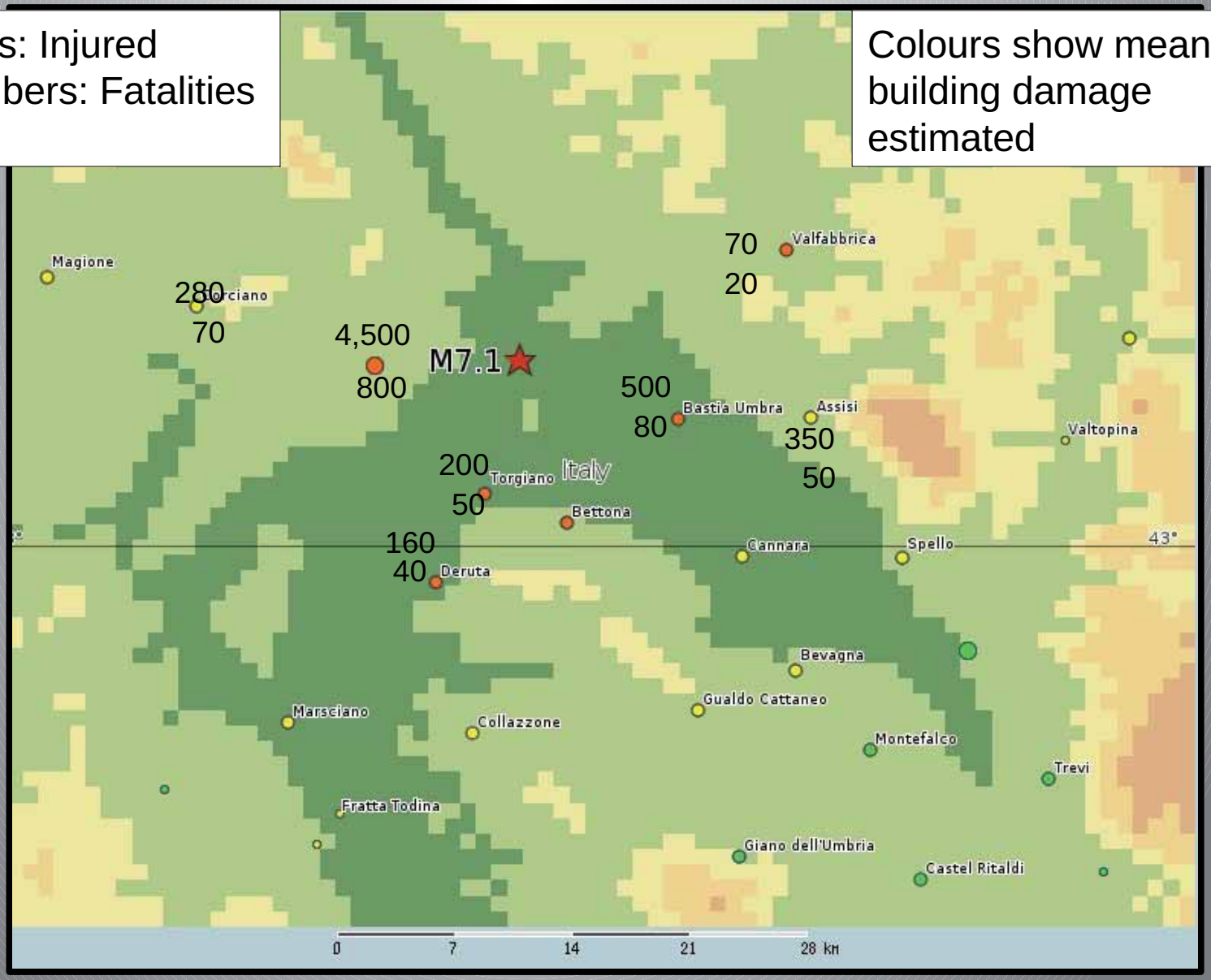

0 - 0.5
0.5 - 1.5
1.5 - 2.5
2.5 - 3.5
3.5 - 4.5
>4.5
M7.1
Mean building damage estimated
0
58
116
174
232 km



Mean building damage estimated

Top Numbers: Injured
Bottom Numbers: Fatalities estimated

Colours show mean building damage estimated

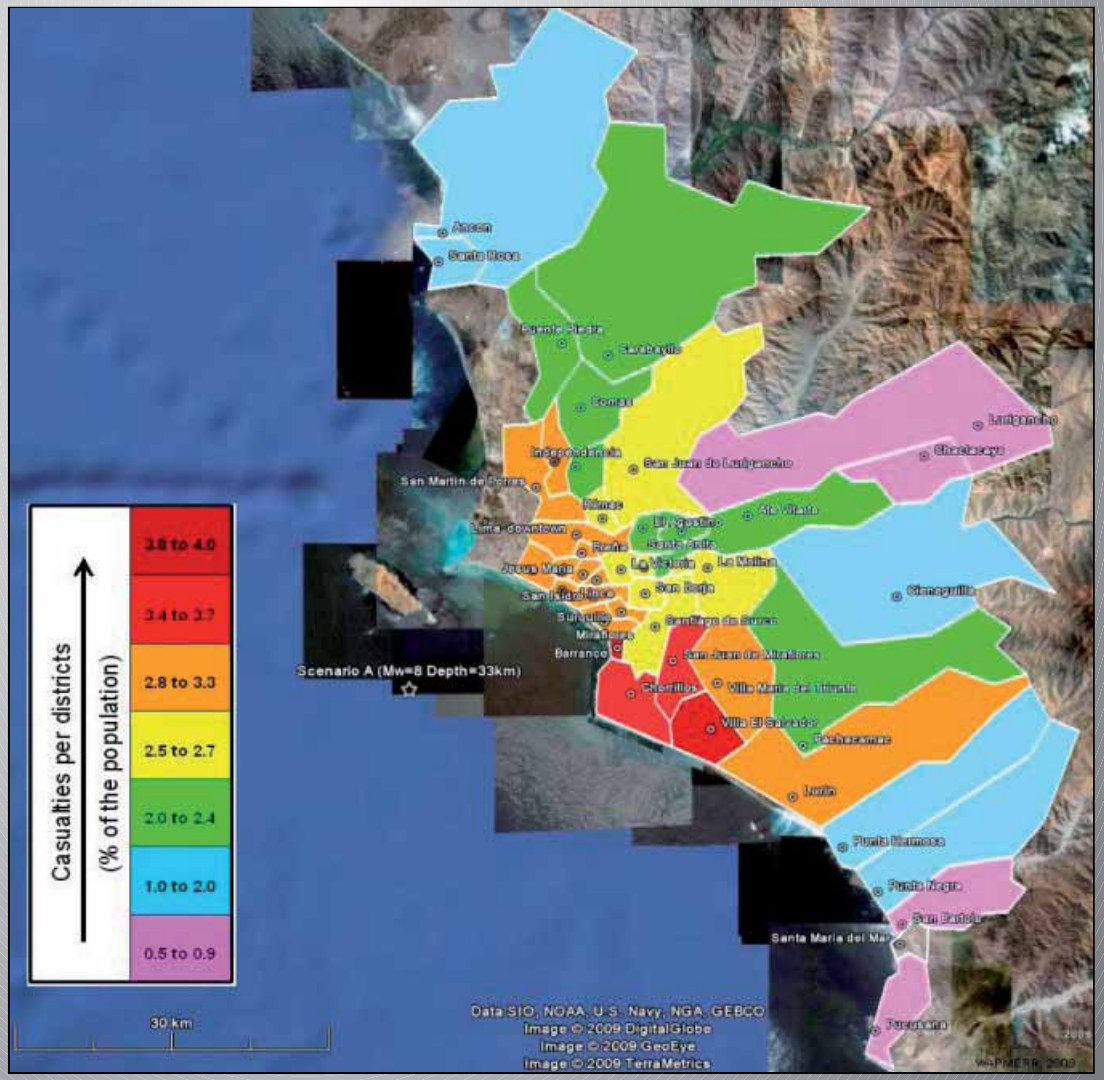


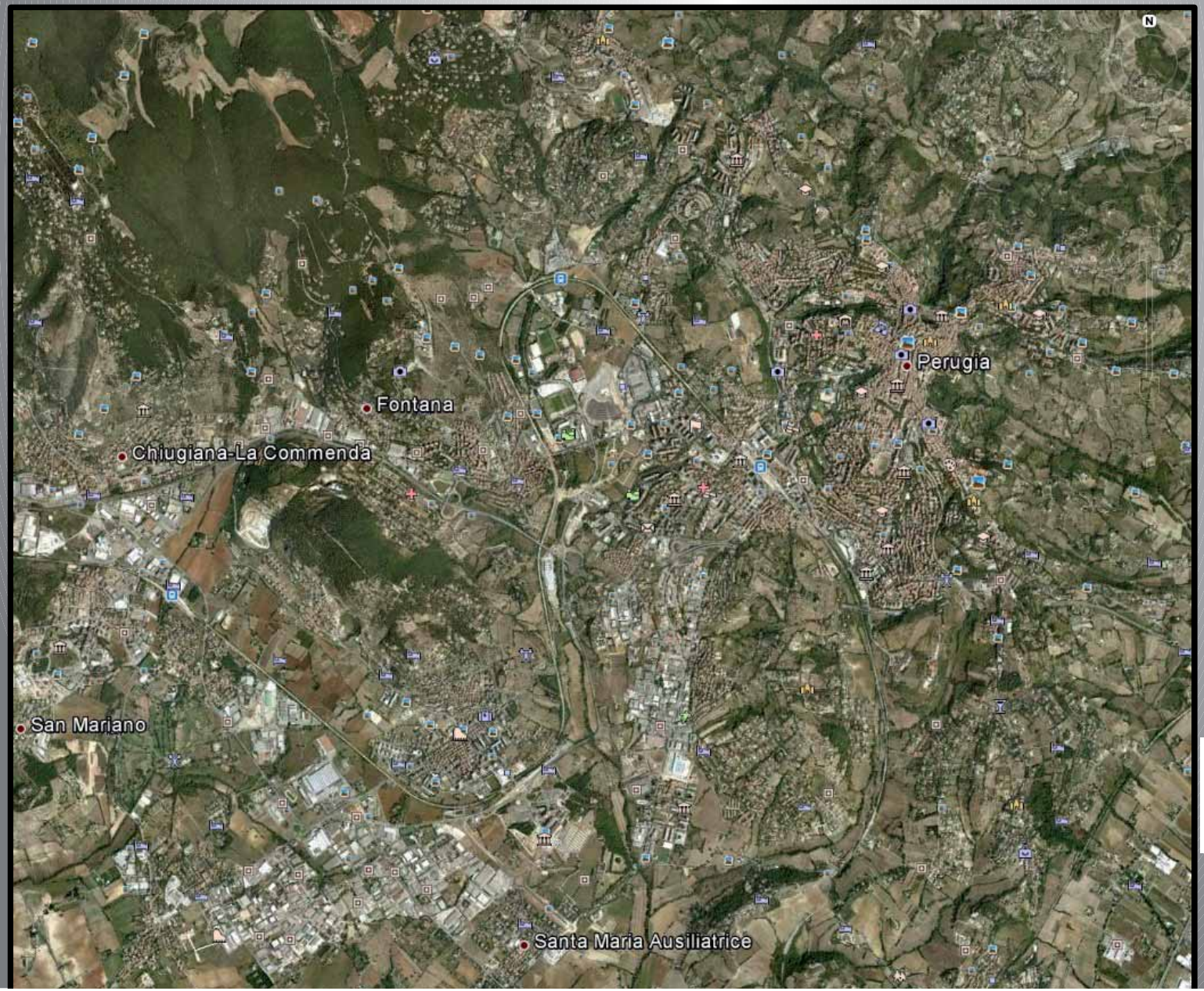
City model

- For 2.6 million settlements worldwide we have coordinates, population, building fragility
- For special cities we have information on districts and soil conditions

QLARM output for large cities

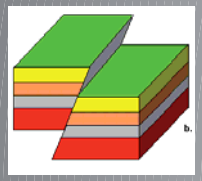
Example Lima, Peru





Example
Perugia

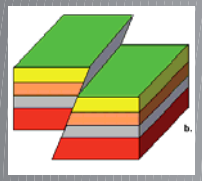
How do we calculate losses due to earthquakes?



Earthquake

Accurate parameters: X, Y, Z, M

Help injured

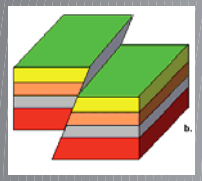


Earthquake

Accurate parameters: X, Y, Z, M

⇩

Earth transmission properties: ground motion



Earthquake

Accurate parameters: X, Y, Z, M

⇩

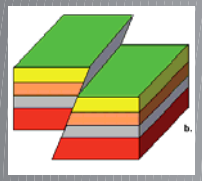
Earth transmission properties: ground motion

⇦

Building fragility data base

⇦

Damage to buildings



Earthquake

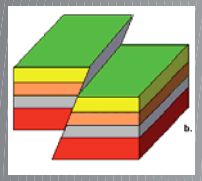
Accurate parameters: X, Y, Z, M

Earth transmission properties: ground motion

Building fragility data base

Damage to buildings

Population data base



Earthquake

Accurate parameters: X, Y, Z, M

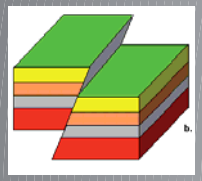
Earth transmission properties: ground motion

Building fragility data base

Damage to buildings

Population data base

Casualty Matrix



Earthquake

Accurate parameters: X, Y, Z, M

Earth transmission properties: ground motion

Building fragility data base

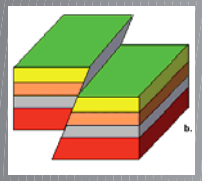
Damage to buildings

Population data base

Casualty Matrix

Estimated Results:
- Building damage
- Number of fatalities
- Number of injured

THE JOB OF WAPMERR



Earthquake

Accurate parameters: X, Y, Z, M

Earth transmission properties: ground motion

Building fragility data base

Damage to buildings

Population data base

Casualty Matrix

Estimated Results:
- Building damage
- Number of fatalities
- Number of injured

THE JOB OF WAPMERR

Responsible Government Rescue Agency:
- mobilizing (yes/no)
- Offer help (yes/no)

Disaster Manager: accept help (yes/no)

Help injured

CONCLUSIONS

You may expect from me:

Real time as well as scenario loss estimates for earthquakes

www.wapmerr.org

NOTE

Alert service by email for major earthquakes worldwide is free

Ask for it at: max_wyss@qlarm.com

Thank you for your attention