REAL-TIME SHAKE MAPS IN SOUTHERN ALPS AREA: GENERATION AND CALIBRATION







Ground motion relations

- Database DST (1993-2005) + ESD (F76, BO98
- Motion components: PVA, PHA(lc), PHA(va).
- Frequency range: 0.1-30 Hz.
- Our database has the MI estimation only from 2003!
- For the same event we extracted the MI values from different agencies; the dati have been compared.
- We extrapolated the missing values doing a regression with data from the OGS catalogue (Bragato and Slejko, 2005).

Magnitude range (Ml): 3.0-6.3. Epicentral distance: 1-100 km.

Site effects: $>S=0 \rightarrow Bedrock.$ $>S=1 \rightarrow Soil.$



AUG, Trieste - February 27-28, 2007

ANALYSIS

1. Linear regression (least square method).

2. Estimation of *h* parameter:

- 1. Model with $0 \le h \le 20$;
- 2. Computation of R^2 parameter;
- 3. Selection of h with the highest \mathbb{R}^2 value.

3. Correction factors:

- Magnitude saturation (Lee and Trifunac, 1995): M², M³;
- Dependence between the magnitude and the distance (Anderson, 2000): r*Mⁿ, log(r)*Mⁿ con n=1,2,3.
- \blacktriangleright What is the best? => ANOVA test (lc 95%).

FINAL MODEL:

$\log_{10}(PGA) = c_0 + c_1 \cdot M + c_2 \cdot M^3 + (c_3 + c_4 \cdot M^3) \cdot \log_{10}(\sqrt{d^2 + h^2}) + c_s \cdot S \pm \sigma$

Comparison with AS96 and SP96

Fixed distance: 20 and 40 km. Fixed magnitude: 5.0 and 6.0.

RAF has stronger attenuation than AS96 and SP96 for MI<5.0 d>20 km





Friuli earthquake (Ml=6.3)



DST Rapid Instrumental Intensity Map Epicenter: FRIULI Thu May 6, 1976 09:00:13 PM CST M 6.3 N46.29 W13.25 Depth: 7.0km ID:7605062000



Processed: Mon Feb 13, 2006 02:37:34 PM CST, - NOT REVIEWED BY HUMAN

PERCEIVED SHAKING	Notfelt	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)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(om/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	IF III	IV	V	VI	VII	VIII	IX	X+

Scenario of the seismic event of Bovec (SLO) 2004

Event	Hypocenter		Reference Position		h (km)	dip (°)	strike (°)	rake (°)	NP	Mw	M ₀ (Nm)
Bovec	Lon Lat	13°36'47'' 46°18'43''	Lon Lat	13°38'42'' 46°17'11''	7	87	127	175	24,16	5.4	3.5*10 ¹⁶



0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

STA	Lon	Lat	Real	CALC	
			cm/s ²		
KBA	13.3447	47.0784	0.1320	0.127955	
AUPA	13.2563	46.5064	0.5400	0.432598	
WTTA	11.6363	47.2638	0.0850	0.237346	
MOGG	13,189	46,406	0.3890	0.453488	
STOL	13.3554	46.3614	0.7200	0.952635	
CESC	13.057	46.356	0.2830	0.287371	
GEPF	13.1405	46.2772	0.9430	0.175036	
PRAD	12,889	46,248	0.1860	0.120016	
VINO	13.281	46.256	0.7800	0.225069	
MAJA	13.0689	46.1823	0.8300	0.124096	
MASA	13.4323	46.177	0.4900	1.01129	
TRI	13.7642	45.709	0.1130	6.55E-02	
DST2	13.8013	45.6587	0.1950	4.64E-02	
KNDS	14.377	45.528	0.1370	0.245397	
CEY	14.4221	45.7381	0.0880	0.32885	
CADS	13.737	46.228	1.7100	1.45257	
LJU	14.5278	46.0438	0.3200	0.403437	
CRES	15.4569	45.826	0.0770	0.174278	
OBKA	14.5489	46.5092	0.2300	0.259614	
ARSA	15.5232	47.2505	0.0910	0.212786	















km o10 o 20 30 D. 10 20 30 n Processed: Tue Feb 13, 2007 45.5° 45.5 12° 12° 13° Processed: Tue Feb 13, 2007 12:16:16 P Processed: Tue Feb 13, 2007 12:16:16 PM CST, -- NOT REVIEWED BY HUMAN PERCEIVED SHAKING Not felt Weak Light Moderate Strong Very strong Severe Violent Extreme POTENTIAL none none none Very light Light Moderate Moderate/Heavy Heavy Very Heavy AUG, Tries .02-.28 .28-.92 .92-3.0 3.0-9.7 9.7-31 101-329 PEAK ACC.(%g) <.02 31-101 >124

<.01

1

.01-.13

11-111

.13-.47

IV

.47-1.6

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1.6-6.0

VI

6.0-21

VII

21-78

VIII

78-281

IX

>281

X+

PEAK VEL.(cm/s)

INSTRUMENTAL INTENSITY

45.5°

12°

o10 o 20



DST Peak Accel. Map (in %g) Epicenter: NORTHERN ITALY Mon Feb 26, 2007 06:50:46 AM CST M 4.4 N46 24 W12 54 Depth: 5.2km JD:7705



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PERCEIVED SHAKING	Notfelt	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)	<.02	.0228	.2892	.92-3.0	3.0-9.7	9.7-31	31-101	101-329	>124
PEAK VEL.(om/s)	<.01	.0113	.1347	.47-1.6	1.6-6.0	6.0-21	21-78	78-281	>281
INSTRUMENTAL INTENSITY	I	IFIII	IV	V	VI	VII	VIII	IX	X+

Conclusions

• Shake Maps:

Ground motion relations (PGA, PGV, SA). **Relation** Between ground-motion and MMI. □Soil classification (EC8, NEHRP, regional map). **Recording stations and spacing grid are critical.** > Testing the influence of different soil classification. >Maps validation computing seismograms of significative earthquakes in Southern Alps. Software implementation with computation of synthetic seismograms instead of empirical laws.

THE END

Thank you for your attention!

Further informations: www.dst.units.it/RAF06