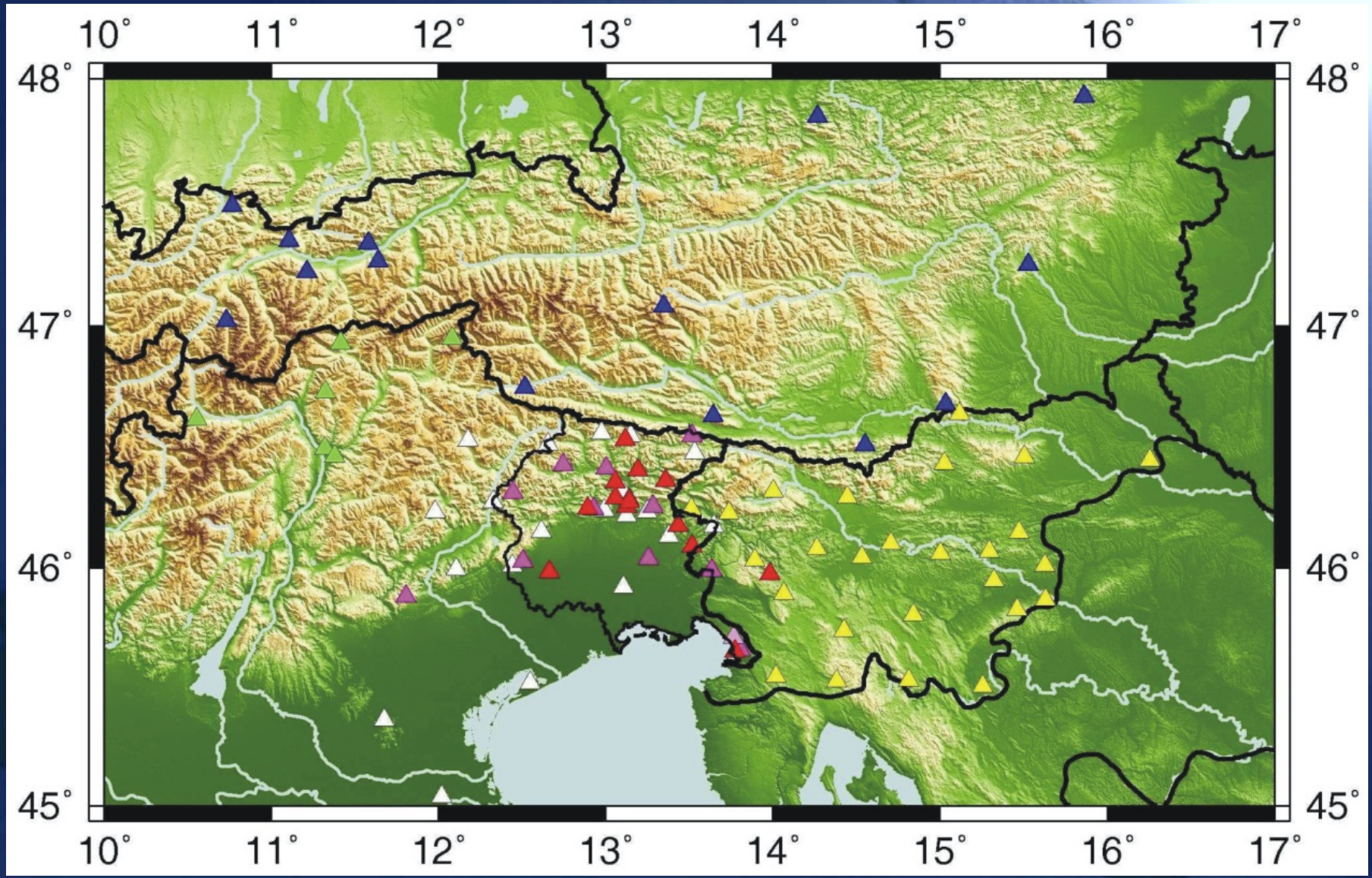
Antelope at University of Trieste

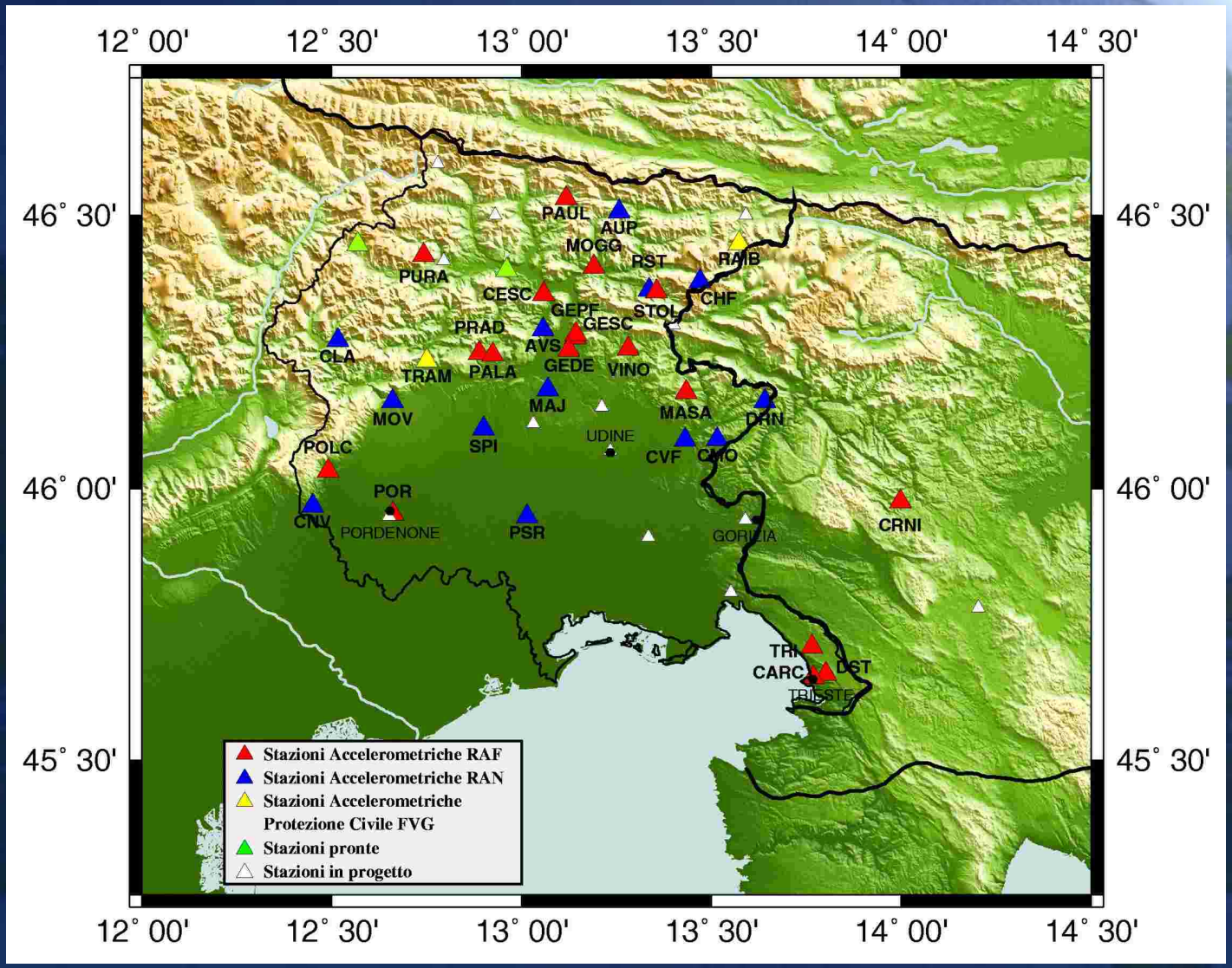
Dipartimento di Geoscienze – University of Trieste

Giovanni Costa

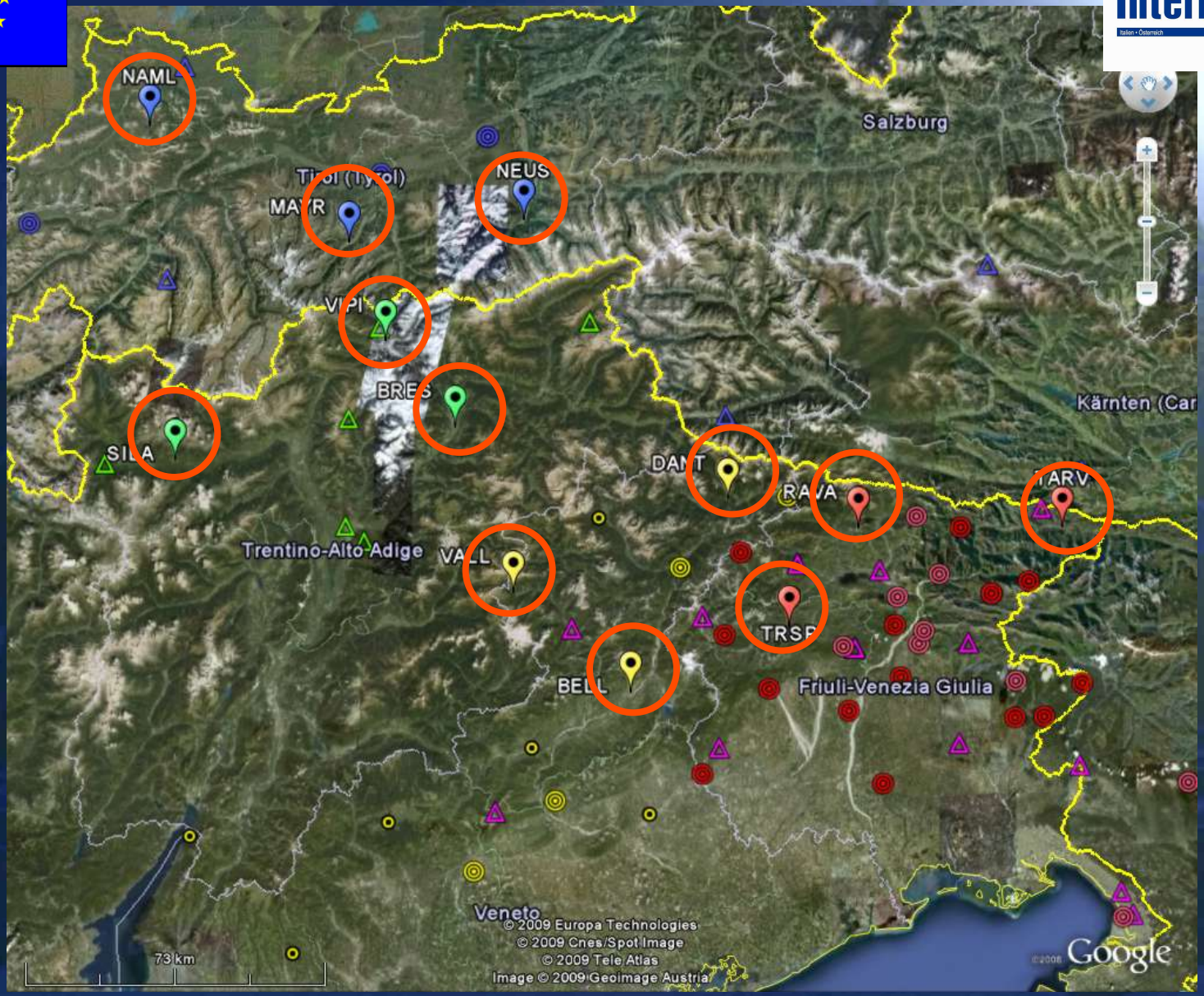
The Eastern-Southern Alps Transfrontalier Network



Integrated Network RAF-RAN



RAN – National Accelerometric Network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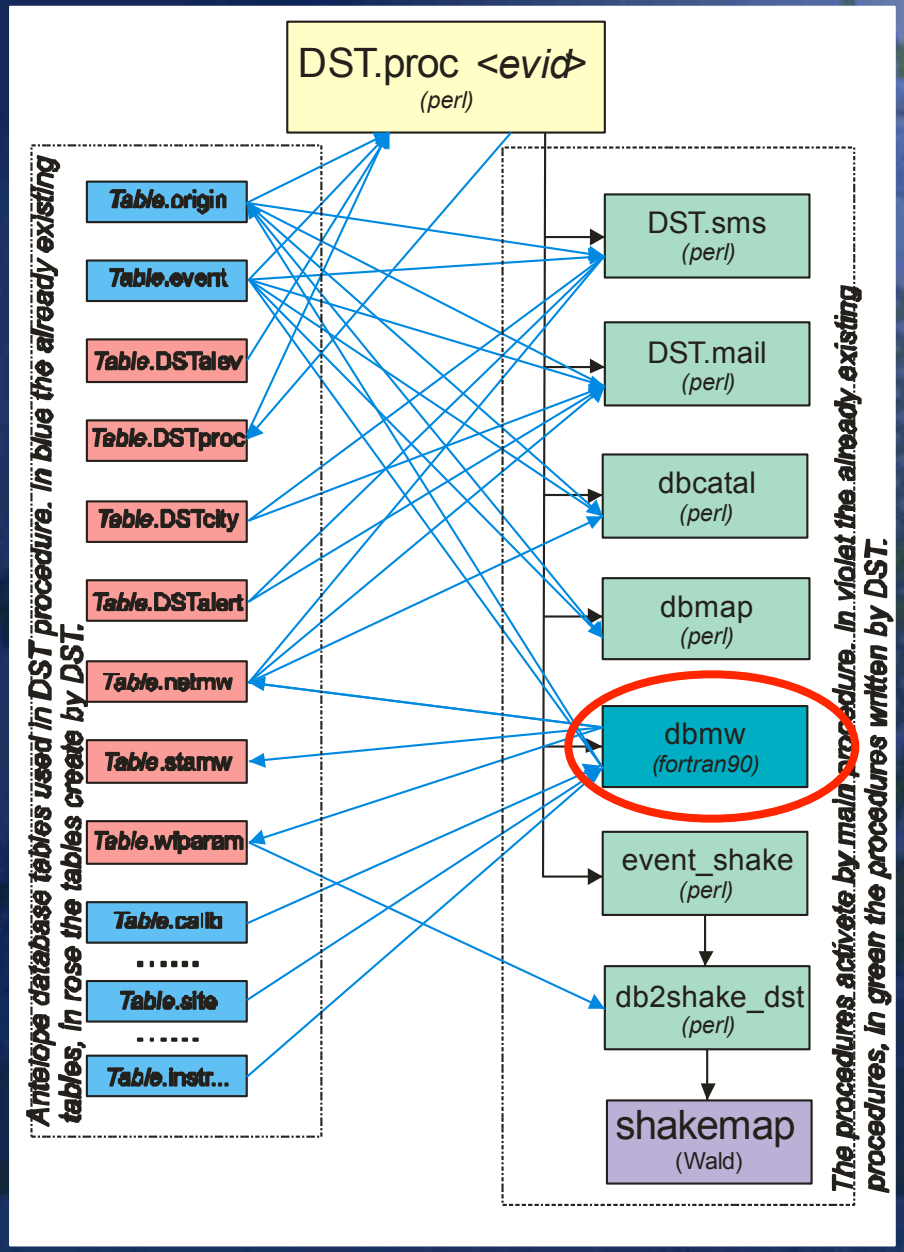

DST.proc <evid>
(perl)
Table.origin
Table.event
Table.DSTalev
Table.DSTproc
Table.DSTcity
Table.DSTalert
Table.netmw
Table.stamw
Table.wfparam
Table.calib
.....
Table.site
.....
Table.instr...
Antelope database tables used in DST procedure. In blue the already existing tables, in rose the tables create by DST.
DST.sms
(perl)
DST.mail
(perl)
dbcatal
(perl)
dbmap
(perl)
dbmw
(fortran90)
event_shake
(perl)
db2shake_dst
(perl)
shakemap
(Wald)
The procedures activete by main procedure. In violet the already existing procedures, in green the procedures written by DST.

FAST MOMENT MAGNITUDE ESTIMATION

The signal, in acceleration or displacement, and the instrument response are extracted from the database of the Antelope system

↓

Average and instrument response are removed and bandpass filter applied

↓

EW and NS components are combined to obtain the trasversal one to minimize P-wave interferences

↓

"noise" window and "S" window are retrieved

↓

Signal-to-Noise spectral ratio is used to determine the frequency window

↓

Integrate to obtain velocities and displacements

↓

FFT
Correction for geometrical spreading and anelastic attenuation

↓

Velocity and displacement spectra estimated at the source

↓

Seismic moment and the corner frequency are determined following Andrews method

↓

Results are stored in new database tables

Method used to determinate Mw

(Andrews, 1986)

Spectral amplitude at receiver $A(f) = D(f)\,E(f)\,G(R)$

Brune (1970) source spectrum

$$D(f) = \frac{M_0}{4\pi k^3}\left[1 + \left(\frac{f}{f_0}\right)^2\right]^{-1}$$

Attenuation

$$E(f) = e^{-\frac{\pi f}{Q(f)}}$$

$$Q(f) = 80 f^{1.1}$$

Geometrical spreading

$$G(R) = \frac{1}{R}$$

$$SV2 = 2\int_0^{\infty} V^2(f)\,df \rightarrow SV2 = \frac{1}{4}\pi^2 f_0^3$$

$$SD2 = 2\int_0^{\infty} D^2(f)\,df \rightarrow SD2 = \frac{1}{4}\pi^2 f_0$$

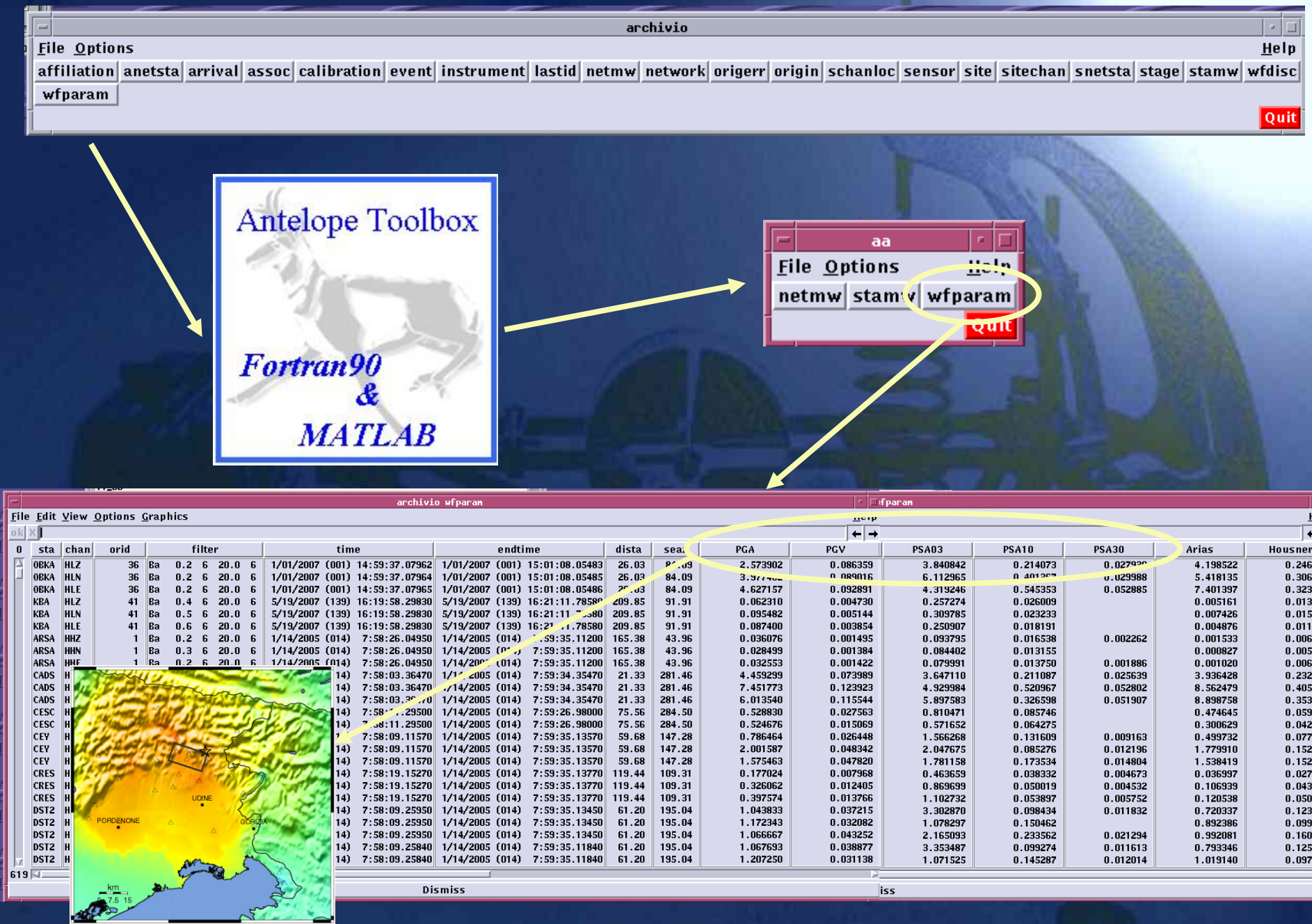
$$\sqrt{4\,SD2^{3/2}\,SV2^{1/2}}$$

$$f_0 = \frac{1}{2}\sqrt{\frac{SV2}{SD2}}$$

$$M_0 = 4\pi^3 k$$

$$r = \frac{2.34}{2\pi f_0}$$

$$M_W = \frac{2}{3}\log_{10} M_0 - 6.1$$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0	sta	chamw	orid	evid	mw	m0	f0	eqR	distmw	rotaz	timePmw	Pmw	timeSmw	Smw
	OBKA	HLT	36	4	4.05	0.167E+16	1.33	0.95	26.03	-5.91	1/01/2007 (001) 14:59:50.07680	db	1/01/2007 (001) 14:59:53.68857	synt
	KBA	HLT	41	5	4.12	0.214E+16	1.88	0.67	209.85	1.91	5/19/2007 (139) 16:20:11.29461	synt	5/19/2007 (139) 16:20:35.98865	synt
	ARSA	HHT	1	2	4.34	0.462E+16	0.58	2.17	165.38	-46.04	1/14/2005 (014) 7:58:39.04890	db	1/14/2005 (014) 7:58:58.96494	synt
	CADS	HHT	1	2	3.77	0.642E+15	2.07	0.61	21.33	191.46	1/14/2005 (014) 7:58:16.36330	db	1/14/2005 (014) 7:58:20.28700	db
	CESC	HGT	1	2	3.84	0.816E+15	2.51	0.50	75.56	194.50	1/14/2005 (014) 7:58:24.29717	db	1/14/2005 (014) 7:58:34.57609	synt
	CEY	HHT	1	2	3.80	0.703E+15	2.90	0.44	59.68	57.28	1/14/2005 (014) 7:58:22.11465	db	1/14/2005 (014) 7:58:29.90775	synt
	CRES	HHT	1	2	4.02	0.153E+16	2.31	0.55	119.44	19.31	1/14/2005 (014) 7:58:32.15241	db	1/14/2005 (014) 7:58:47.53452	synt
	DST2	HGT	1	2	4.00	0.142E+16	1.91	0.66	61.20	105.04	1/14/2005 (014) 7:58:22.25932	db	1/14/2005 (014) 7:58:30.35395	synt
	DST2	HHT	1	2	4.01	0.148E+16	1.88	0.67	61.20	105.04	1/14/2005 (014) 7:58:22.25932	db	1/14/2005 (014) 7:58:30.35395	synt
	GEDE	HGT	1	2	4.01	0.144E+16	1.70	0.74	68.58	186.25	1/14/2005 (014) 7:58:23.83805	synt	1/14/2005 (014) 7:58:32.52201	synt
	GEPF	HGT	1	2	3.82	0.753E+15	1.64	0.77	67.73	188.31	1/14/2005 (014) 7:58:23.74696	db	1/14/2005 (014) 7:58:32.27160	synt
	JAVS	HHT	1	2	3.61	0.371E+15	3.62	0.35	33.21	83.81	1/14/2005 (014) 7:58:18.14953	db	1/14/2005 (014) 7:58:23.82752	db
	KBA	HHT	1	2	3.81	0.733E+15	1.00	1.26	111.06	243.05	1/14/2005 (014) 7:58:31.07663	db	1/14/2005 (014) 7:58:45.05519	synt
	KBA	HLT	1	2	3.82	0.751E+15	1.46	0.87	111.06	243.05	1/14/2005 (014) 7:58:31.07663	db	1/14/2005 (014) 7:58:45.05519	synt
	KNDS	HHT	1	2	3.97	0.125E+16	2.06	0.61	79.10	68.58	1/14/2005 (014) 7:58:24.92216	db	1/14/2005 (014) 7:58:35.61724	synt
	LJU	HHT	1	2	3.86	0.876E+15	3.32	0.38	43.38	21.87	1/14/2005 (014) 7:58:20.13214	db	1/14/2005 (014) 7:58:26.48905	db
	OBKA	HHT	1	2	3.92	0.106E+16	1.91	0.66	54.77	-40.56	1/14/2005 (014) 7:58:21.60316	db	1/14/2005 (014) 7:58:28.74147	db
	OBKA	HLT	1	2	4.12	0.213E+16	1.89	0.67	54.77	-40.56	1/14/2005 (014) 7:58:21.60316	db	1/14/2005 (014) 7:58:28.74147	db
	TRI	HHT	1	2	3.47	0.228E+15	5.58	0.23	56.77	109.53	1/14/2005 (014) 7:58:21.54996	db	1/14/2005 (014) 7:58:29.05510	synt
	VISS	HHT	1	2	3.99	0.138E+16	1.94	0.65	77.55	33.41	1/14/2005 (014) 7:58:25.35721	db	1/14/2005 (014) 7:58:35.16232	synt
	CADS	HHT	2	8	3.51	0.264E+15	2.42	0.52	22.75	192.49	1/14/2005 (014) 8:05:22.69721	synt	1/14/2005 (014) 8:05:27.52159	db
	CEY	HHT	2	8	3.75	0.603E+15	2.78	0.46	58.53	57.82	1/14/2005 (014) 8:05:28.64707	synt	1/14/2005 (014) 8:05:36.09128	synt
	DST2	HGT	2	8	3.59	0.346E+15	3.17	0.40	60.96	106.59	1/14/2005 (014) 8:05:29.06021	synt	1/14/2005 (014) 8:05:36.80382	synt
	DST2	HHT	2	8	3.58	0.335E+15	3.30	0.38	60.96	106.59	1/14/2005 (014) 8:05:29.06021	synt	1/14/2005 (014) 8:05:36.80382	synt
	GEDE	HGT	2	8	3.94	0.116E+16	1.57	0.80	69.84	186.71	1/14/2005 (014) 8:05:30.57214	synt	1/14/2005 (014) 8:05:39.41159	synt

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	1	2	3.90	4.69	0.15	0.123E+16	2.24	0.71	18	3	dbmw11	10/10/2008 (284) 6:15:40.80706
	2	8	3.69	4.30	0.06	0.531E+15	2.80	0.49	11	2	dbmw11	10/10/2008 (284) 6:16:33.69589
	4	15	2.44	2.19	0.09	0.889E+13	2.18	0.58	2	13	dbmw11	10/10/2008 (284) 6:17:18.77001
	6	25	3.10	3.50	0.08	0.758E+14	2.66	0.53	11	9	dbmw11	10/10/2008 (284) 6:18:01.72892
	7	26	3.57	3.87	0.19	0.463E+15	1.69	0.80	8	0	dbmw11	10/10/2008 (284) 6:18:57.24420
	10	19	2.09	2.08	0.00	0.192E+13	6.90	0.18	1	16	dbmw11	10/10/2008 (284) 6:19:12.00199
	11	27	2.35	2.43	0.01	0.499E+13	3.72	0.34	2	20	dbmw11	10/10/2008 (284) 6:19:36.83049
	20	23	2.45	2.53	0.22	0.954E+13	3.71	0.45	10	17	dbmw11	10/10/2008 (284) 6:20:16.58919
	21	12	2.96	2.68	0.30	0.709E+14	1.22	1.29	7	10	dbmw11	10/10/2008 (284) 6:20:55.89589
	22	13	2.29	2.18	0.00	0.379E+13	3.34	0.38	1	22	dbmw11	10/10/2008 (284) 6:21:08.71346
	33	24	4.45	4.43	0.38	0.168E+17	0.79	2.26	8	3	dbmw11	10/10/2008 (284) 6:22:02.43512
	35	3	3.78	4.01	0.28	0.931E+15	1.62	0.88	26	14	dbmw11	10/10/2008 (284) 6:23:50.49995
	36	4	4.03	4.55	0.27	0.265E+16	1.65	0.89	16	9	dbmw11	10/10/2008 (284) 6:56:48.86256
	37	7	4.57	4.92	0.08	0.125E+17	1.03	1.25	8	2	dbmw11	10/10/2008 (284) 6:57:16.84353
	41	5	4.01	4.03	0.70	0.668E+16	1.27	1.57	5	6	dbmw11	10/10/2008 (284) 6:57:32.78156

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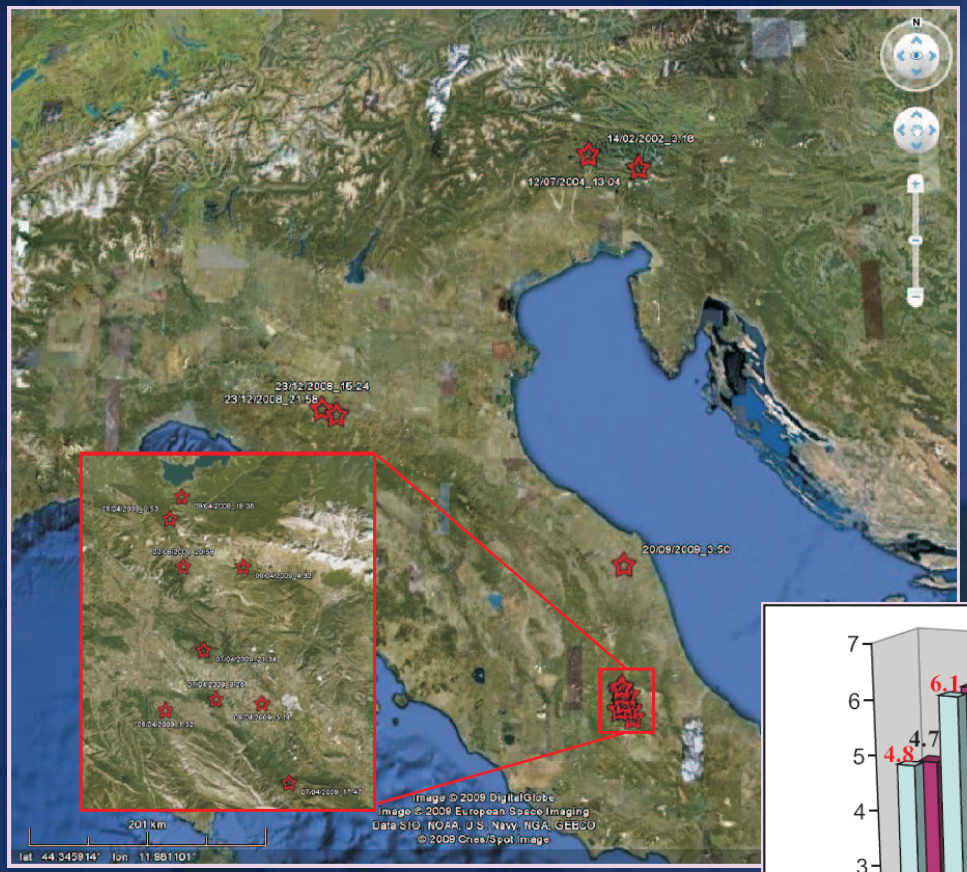
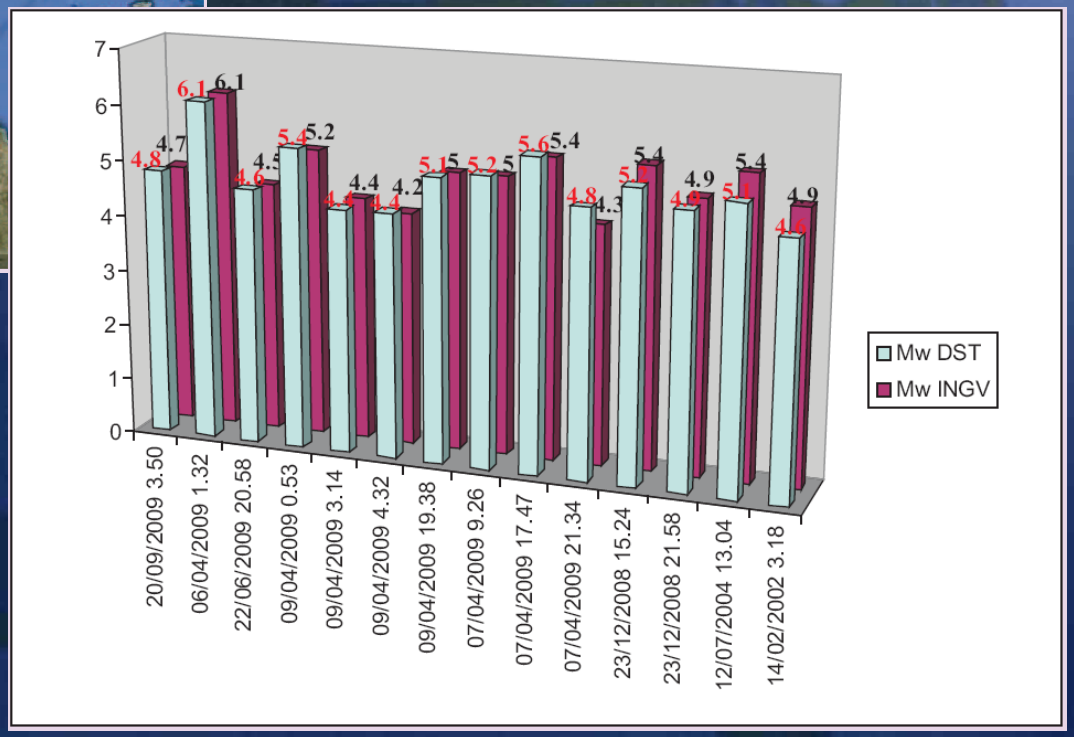
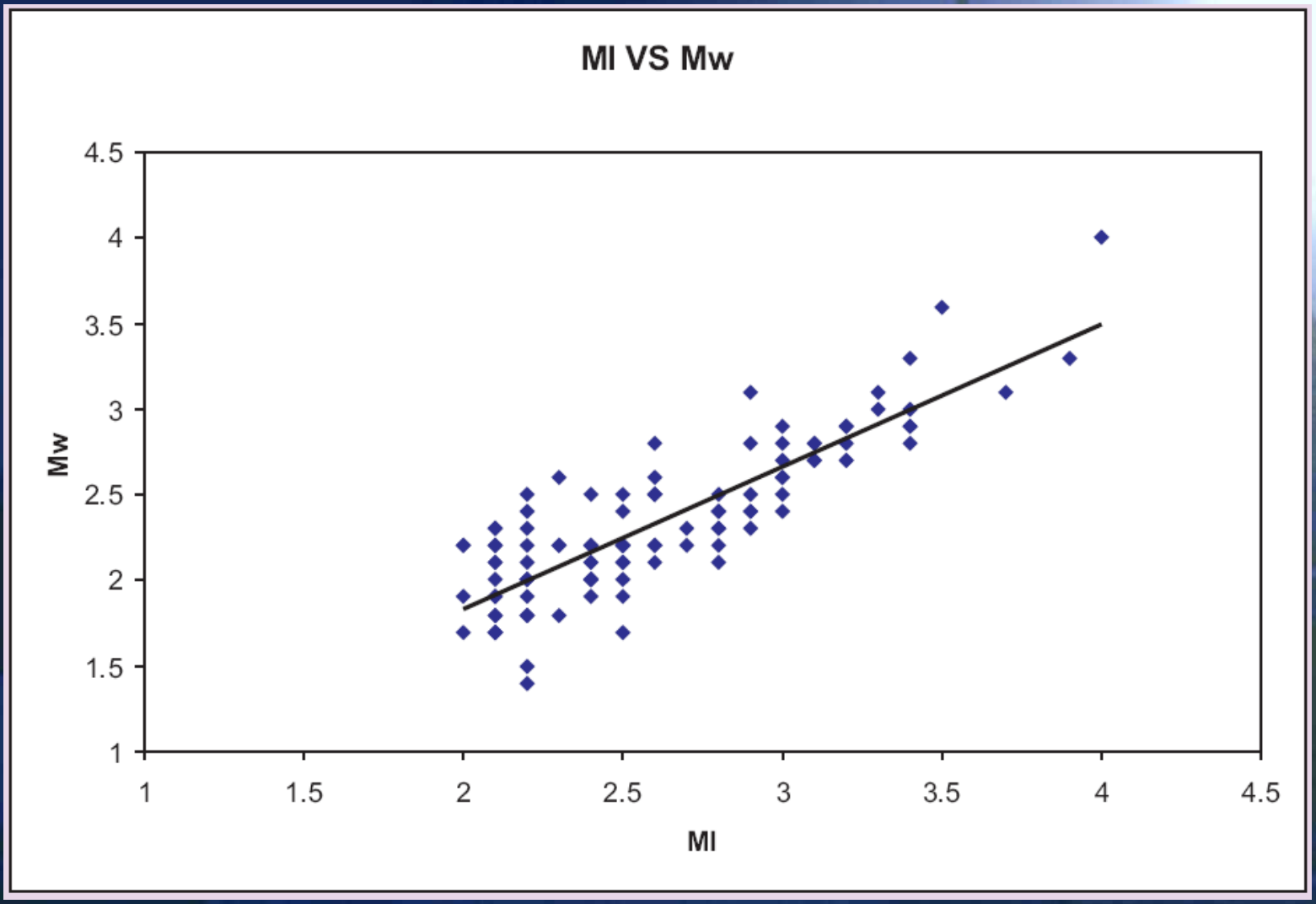


Map of the events, for which an independent MW determination is available, used to test the procedure.

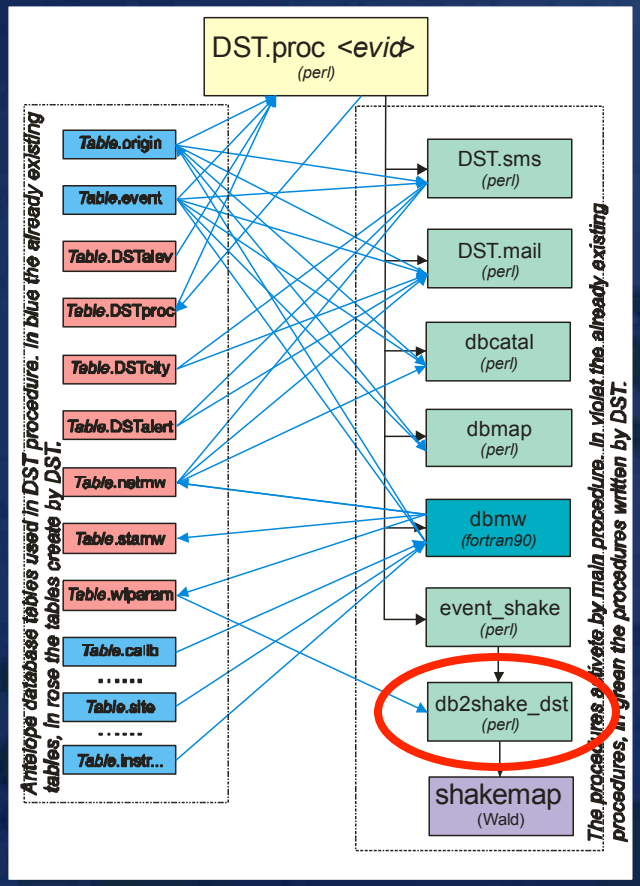


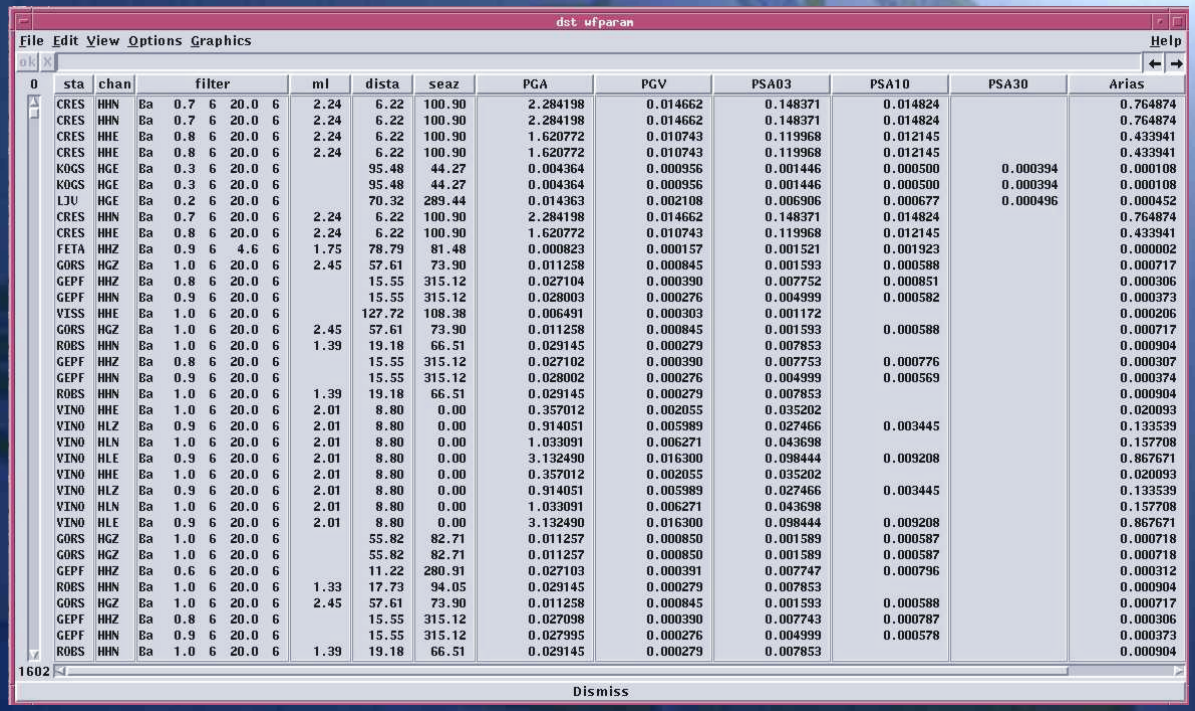
Comparison between moment magnitude determinated at DST and moment magnitude of INGV obtained by waveform inversion. There are in a very good agreement.



Comparison between Ml (determined by Antelope) and Mw (determined by DST) of small events occured in Southeastern Alps.

– DST.proc real-time procedure, “dbmw” module: creation of table “wfparam”





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	CRES	HHN	Ba 0.7 6 20.0 6	2.24	6.22	100.90	2.284198	0.014662	0.148371	0.014824		0.764874
	CRES	HHN	Ba 0.7 6 20.0 6	2.24	6.22	100.90	2.284198	0.014662	0.148371	0.014824		0.764874
	CRES	HHE	Ba 0.8 6 20.0 6	2.24	6.22	100.90	1.620772	0.010743	0.119968	0.012145		0.433941
	CRES	HHE	Ba 0.8 6 20.0 6	2.24	6.22	100.90	1.620772	0.010743	0.119968	0.012145		0.433941
	K0GS	HGE	Ba 0.3 6 20.0 6		95.48	44.27	0.004364	0.000956	0.001446	0.000500	0.000394	0.000108
	K0GS	HGE	Ba 0.3 6 20.0 6		95.48	44.27	0.004364	0.000956	0.001446	0.000500	0.000394	0.000108
	LJU	HGE	Ba 0.2 6 20.0 6		70.32	289.44	0.014363	0.002108	0.006906	0.000677	0.000496	0.000452
	CRES	HHN	Ba 0.7 6 20.0 6	2.24	6.22	100.90	2.284198	0.014662	0.148371	0.014824		0.764874
	CRES	HHE	Ba 0.8 6 20.0 6	2.24	6.22	100.90	1.620772	0.010743	0.119968	0.012145		0.433941
	FETA	HHZ	Ba 0.9 6 4.6 6	1.75	78.79	81.48	0.000823	0.000157	0.001521	0.001923		0.000002
	G0RS	HGZ	Ba 1.0 6 20.0 6	2.45	57.61	73.90	0.011258	0.000845	0.001593	0.000588		0.000717
	GEPF	HHZ	Ba 0.8 6 20.0 6		15.55	315.12	0.027104	0.000390	0.007752	0.000851		0.000306
	GEPF	HHN	Ba 0.9 6 20.0 6		15.55	315.12	0.028003	0.000276	0.004999	0.000582		0.000373
	VISS	HHE	Ba 1.0 6 20.0 6		127.72	108.38	0.006491	0.000303	0.001172			0.000206
	G0RS	HGZ	Ba 1.0 6 20.0 6	2.45	57.61	73.90	0.011258	0.000845	0.001593	0.000588		0.000717
	R0BS	HHN	Ba 1.0 6 20.0 6	1.39	19.18	66.51	0.029145	0.000279	0.007853			0.000904
	GEPF	HHZ	Ba 0.8 6 20.0 6		15.55	315.12	0.027102	0.000390	0.007753	0.000776		0.000307
	GEPF	HHN	Ba 0.9 6 20.0 6		15.55	315.12	0.028002	0.000276	0.004999	0.000569		0.000374
	R0BS	HHN	Ba 1.0 6 20.0 6	1.39	19.18	66.51	0.029145	0.000279	0.007853			0.000904
	VINO	HHE	Ba 1.0 6 20.0 6	2.01	8.80	0.00	0.357012	0.002055	0.035202			0.020093
	VINO	HLZ	Ba 0.9 6 20.0 6	2.01	8.80	0.00	0.914051	0.005989	0.027466	0.003445		0.133539
	VINO	HLN	Ba 1.0 6 20.0 6	2.01	8.80	0.00	1.033091	0.006271	0.043698			0.157708
	VINO	HLE	Ba 0.9 6 20.0 6	2.01	8.80	0.00	3.132490	0.016300	0.098444	0.009208		0.867671
	VINO	HHE	Ba 1.0 6 20.0 6	2.01	8.80	0.00	0.357012	0.002055	0.035202			0.020093
	VINO	HLZ	Ba 0.9 6 20.0 6	2.01	8.80	0.00	0.914051	0.005989	0.027466	0.003445		0.133539
	VINO	HLN	Ba 1.0 6 20.0 6	2.01	8.80	0.00	1.033091	0.006271	0.043698			0.157708
	VINO	HLE	Ba 0.9 6 20.0 6	2.01	8.80	0.00	3.132490	0.016300	0.098444	0.009208		0.867671
	G0RS	HGZ	Ba 1.0 6 20.0 6		55.82	82.71	0.011257	0.000850	0.001589	0.000587		0.000718
	G0RS	HGZ	Ba 1.0 6 20.0 6		55.82	82.71	0.011257	0.000850	0.001589	0.000587		0.000718
	GEPF	HHZ	Ba 0.6 6 20.0 6		11.22	280.91	0.027103	0.000391	0.007747	0.000796		0.000312
	R0BS	HHN	Ba 1.0 6 20.0 6	1.33	17.73	94.05	0.029145	0.000279	0.007853			0.000904
	G0RS	HGZ	Ba 1.0 6 20.0 6	2.45	57.61	73.90	0.011258	0.000845	0.001593	0.000588		0.000717
	GEPF	HHZ	Ba 0.8 6 20.0 6		15.55	315.12	0.027098	0.000390	0.007743	0.000787		0.000306
	GEPF	HHN	Ba 0.9 6 20.0 6		15.55	315.12	0.027995	0.000276	0.004999	0.000578		0.000373
	R0BS	HHN	Ba 1.0 6 20.0 6	1.39	19.18	66.51	0.029145	0.000279	0.007853			0.000904

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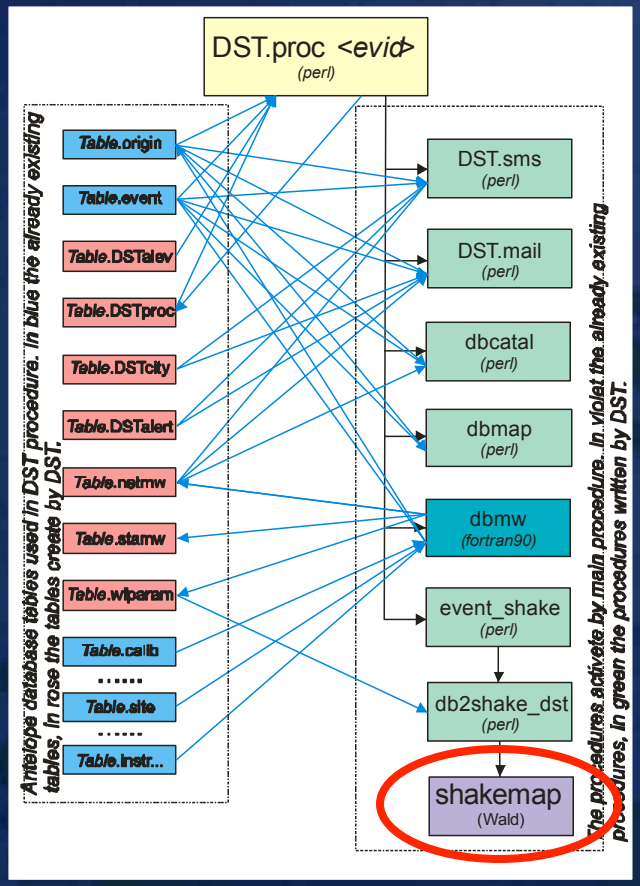
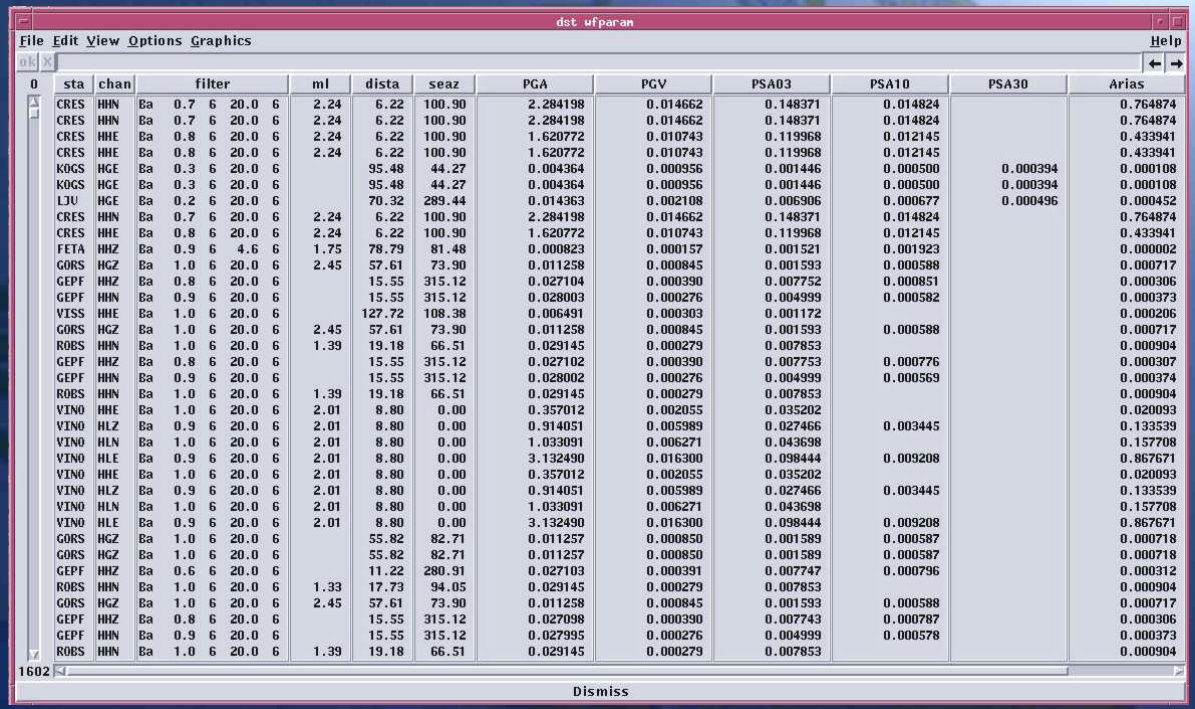
– “db2shake_dst” module: creation of input in XML code

– DST.proc real-time procedure, “dbmw” module: creation of table “wfparam”





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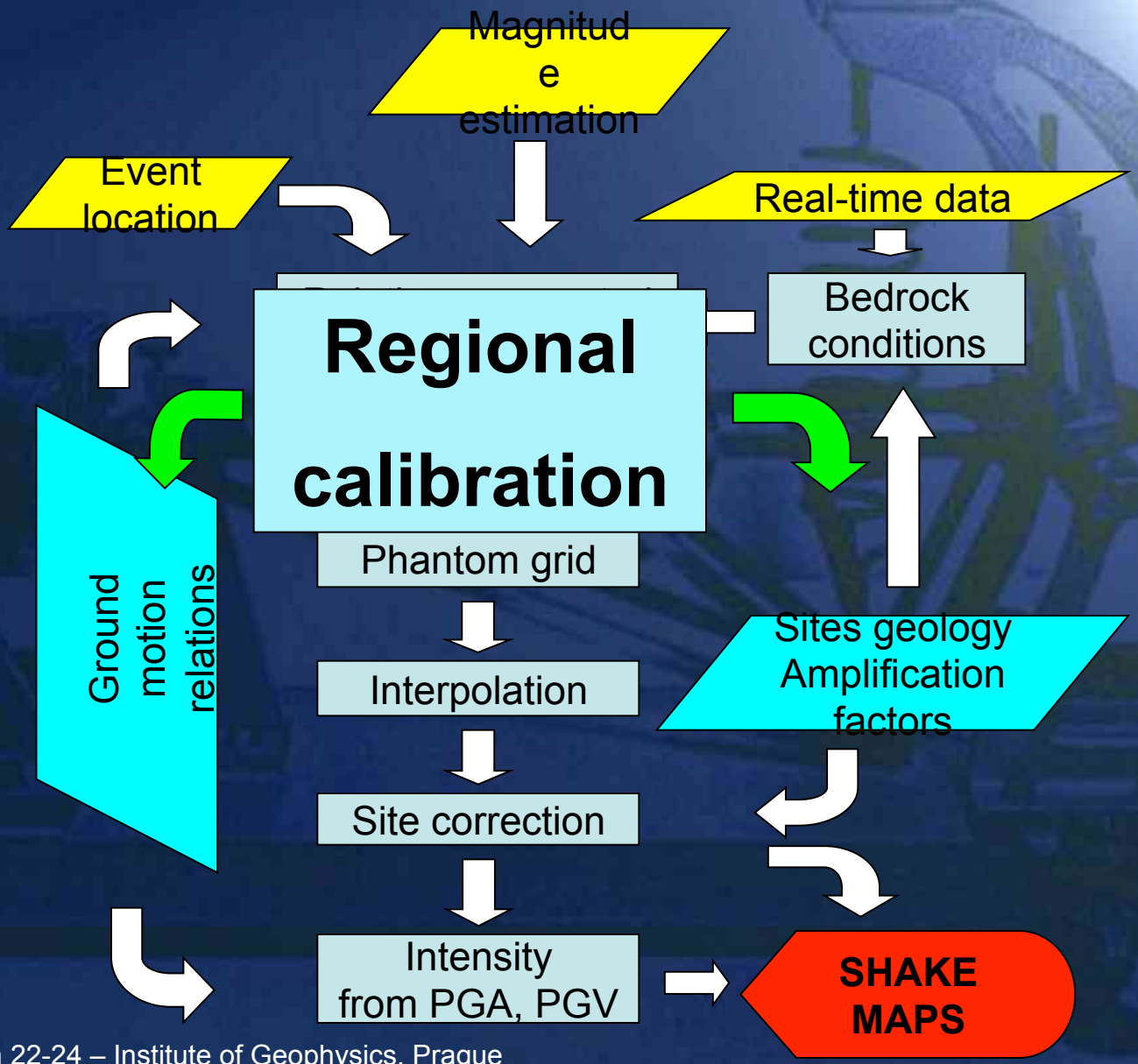
	CRES	HHN	Ba 0.7 6 20.0 6	2.24	6.22	100.90	2.284198	0.014662	0.148371	0.014824		0.764874
	CRES	HHN	Ba 0.7 6 20.0 6	2.24	6.22	100.90	2.284198	0.014662	0.148371	0.014824		0.764874
	CRES	HHE	Ba 0.8 6 20.0 6	2.24	6.22	100.90	1.620772	0.010743	0.119968	0.012145		0.433941
	CRES	HHE	Ba 0.8 6 20.0 6	2.24	6.22	100.90	1.620772	0.010743	0.119968	0.012145		0.433941
	K0GS	HGE	Ba 0.3 6 20.0 6		95.48	44.27	0.004364	0.000956	0.001446	0.000500	0.000394	0.000108
	K0GS	HGE	Ba 0.3 6 20.0 6		95.48	44.27	0.004364	0.000956	0.001446	0.000500	0.000394	0.000108
	LJU	HGE	Ba 0.2 6 20.0 6		70.32	289.44	0.014363	0.002108	0.006906	0.000677	0.000496	0.000452
	CRES	HHN	Ba 0.7 6 20.0 6	2.24	6.22	100.90	2.284198	0.014662	0.148371	0.014824		0.764874
	CRES	HHE	Ba 0.8 6 20.0 6	2.24	6.22	100.90	1.620772	0.010743	0.119968	0.012145		0.433941
	FETA	HHZ	Ba 0.9 6 4.6 6	1.75	78.79	81.48	0.000823	0.000157	0.001521	0.001923		0.000002
	G0RS	HGZ	Ba 1.0 6 20.0 6	2.45	57.61	73.90	0.011258	0.000845	0.001593	0.000588		0.000717
	GEPF	HHZ	Ba 0.8 6 20.0 6		15.55	315.12	0.027104	0.000390	0.007752	0.000851		0.000306
	GEPF	HHN	Ba 0.9 6 20.0 6		15.55	315.12	0.028003	0.000276	0.004999	0.000582		0.000373
	VISS	HHE	Ba 1.0 6 20.0 6		127.72	108.38	0.006491	0.000303	0.001172			0.000206
	G0RS	HGZ	Ba 1.0 6 20.0 6	2.45	57.61	73.90	0.011258	0.000845	0.001593	0.000588		0.000717
	R0BS	HHN	Ba 1.0 6 20.0 6	1.39	19.18	66.51	0.029145	0.000279	0.007853			0.000904
	GEPF	HHZ	Ba 0.8 6 20.0 6		15.55	315.12	0.027102	0.000390	0.007753	0.000776		0.000307
	GEPF	HHN	Ba 0.9 6 20.0 6		15.55	315.12	0.028002	0.000276	0.004999	0.000569		0.000374
	R0BS	HHN	Ba 1.0 6 20.0 6	1.39	19.18	66.51	0.029145	0.000279	0.007853			0.000904
	VINO	HHE	Ba 1.0 6 20.0 6	2.01	8.80	0.00	0.357012	0.002055	0.035202			0.020093
	VINO	HLZ	Ba 0.9 6 20.0 6	2.01	8.80	0.00	0.914051	0.005989	0.027466	0.003445		0.133539
	VINO	HLN	Ba 1.0 6 20.0 6	2.01	8.80	0.00	1.033091	0.006271	0.043698			0.157708
	VINO	HLE	Ba 0.9 6 20.0 6	2.01	8.80	0.00	3.132490	0.016300	0.098444	0.009208		0.867671
	VINO	HHE	Ba 1.0 6 20.0 6	2.01	8.80	0.00	0.357012	0.002055	0.035202			0.020093
	VINO	HLZ	Ba 0.9 6 20.0 6	2.01	8.80	0.00	0.914051	0.005989	0.027466	0.003445		0.133539
	VINO	HLN	Ba 1.0 6 20.0 6	2.01	8.80	0.00	1.033091	0.006271	0.043698			0.157708
	VINO	HLE	Ba 0.9 6 20.0 6	2.01	8.80	0.00	3.132490	0.016300	0.098444	0.009208		0.867671
	G0RS	HGZ	Ba 1.0 6 20.0 6		55.82	82.71	0.011257	0.000850	0.001589	0.000587		0.000718
	G0RS	HGZ	Ba 1.0 6 20.0 6		55.82	82.71	0.011257	0.000850	0.001589	0.000587		0.000718
	GEPF	HHZ	Ba 0.6 6 20.0 6		11.22	280.91	0.027103	0.000391	0.007747	0.000796		0.000312
	R0BS	HHN	Ba 1.0 6 20.0 6	1.33	17.73	94.05	0.029145	0.000279	0.007853			0.000904
	G0RS	HGZ	Ba 1.0 6 20.0 6	2.45	57.61	73.90	0.011258	0.000845	0.001593	0.000588		0.000717
	GEPF	HHZ	Ba 0.8 6 20.0 6		15.55	315.12	0.027098	0.000390	0.007743	0.000787		0.000306
	GEPF	HHN	Ba 0.9 6 20.0 6		15.55	315.12	0.027995	0.000276	0.004999	0.000578		0.000373
	R0BS	HHN	Ba 1.0 6 20.0 6	1.39	19.18	66.51	0.029145	0.000279	0.007853			0.000904

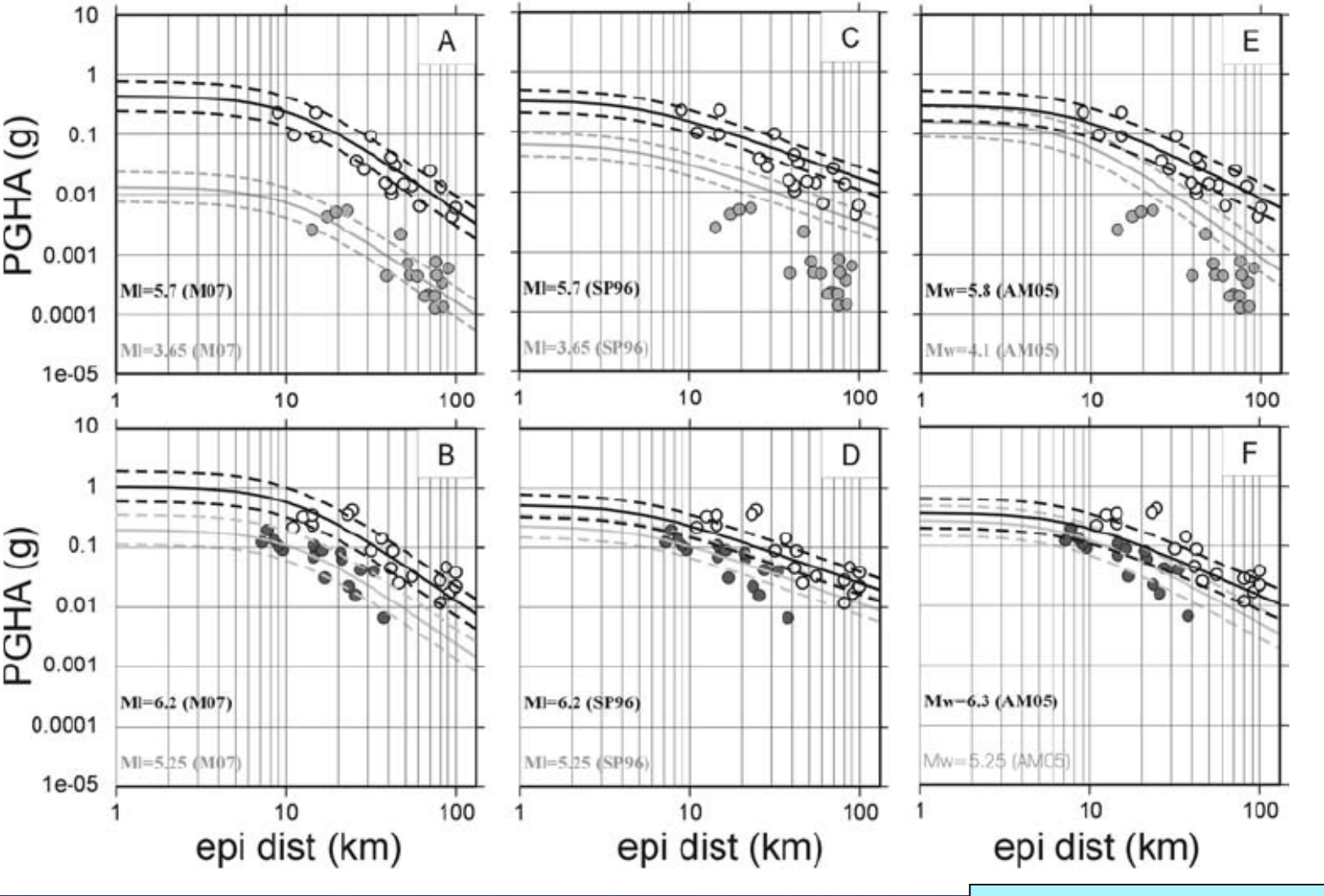
1602

– “db2shake_dst” module: creation of input in XML code

“ShakeMap”

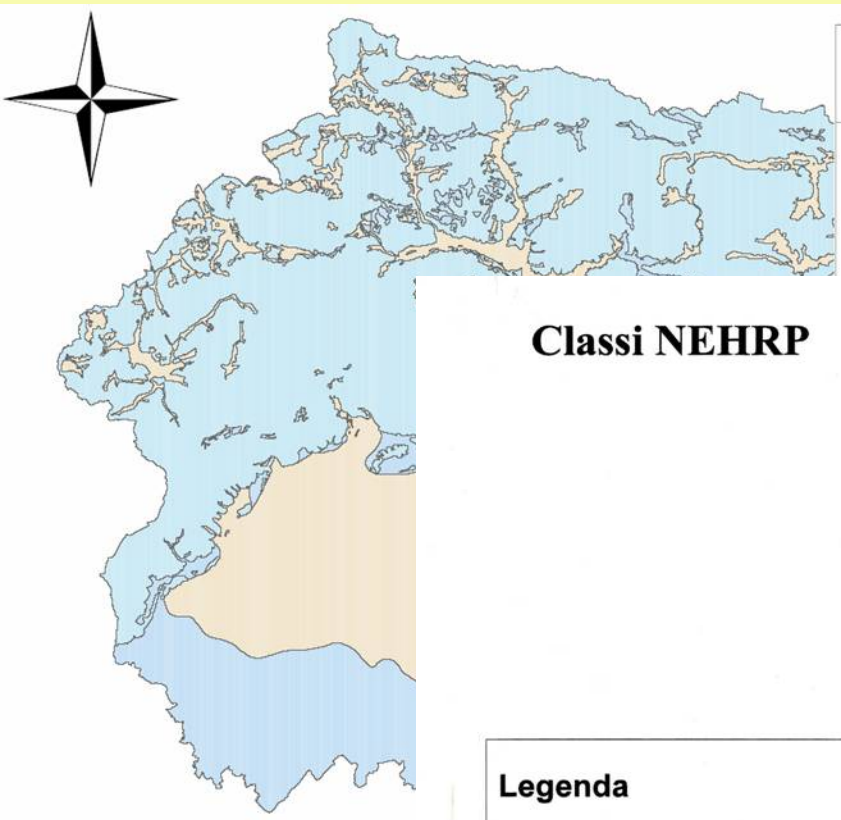

Magnitud
e
estimation
Event
location
Real-time data
Bedrock
conditions
Regional
calibration
Phantom grid
Ground
motion
relations
Interpolation
Sites geology
Amplification
factors
Site correction
Intensity
from PGA, PGV
SHAKE
MAPS

Attenuation relations



(Massa et al., 2008)

Soil geology

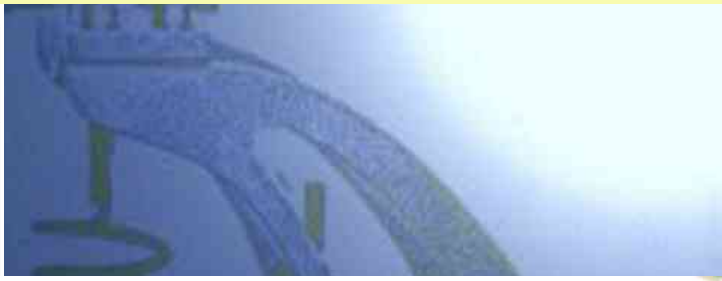


REGIONE AUTONOMA FRIULI VENEZIA GIULIA
PROTEZIONE CIVILE DELLA REGIONE

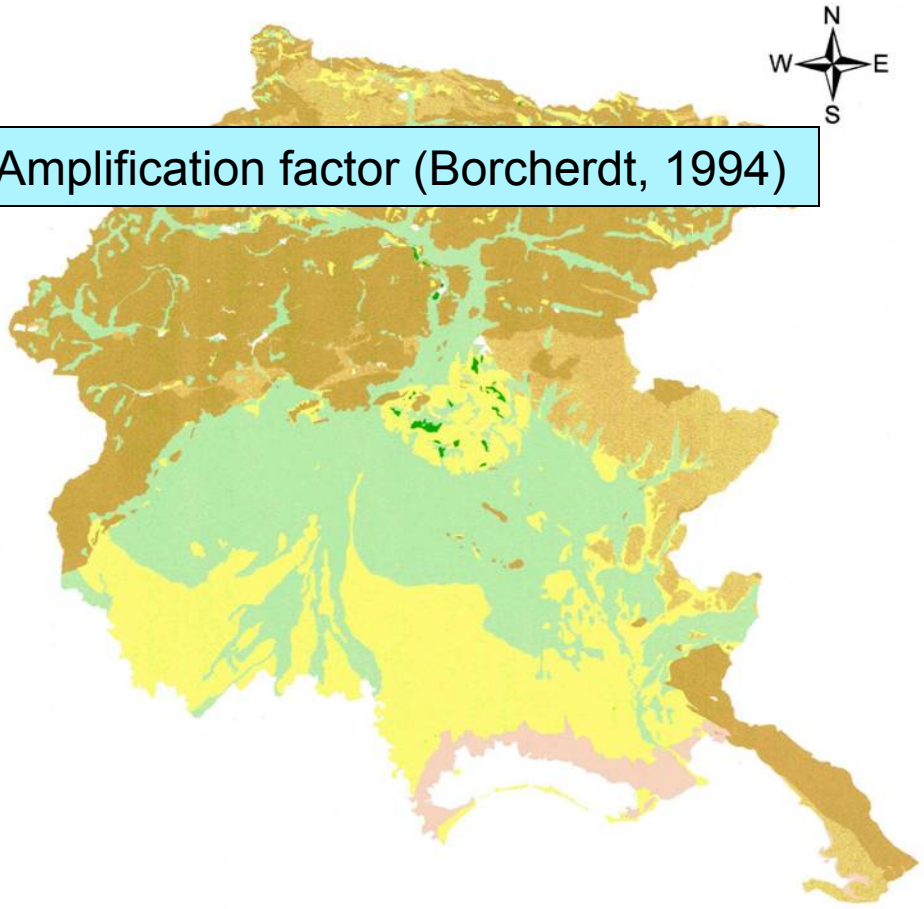
Convenzione per la riclassificazione sismica del territorio della Regione Friuli Venezia Giulia

Allegato 1

CARTA GEOLOGICA PRELIMINARE



Classi NEHRP



Legenda

- A rocce "massicce"
- B rocce "stratificate"
- C sedimenti ghiaiosi
- D sedimenti sabbiosi, limosi e glaciali
- E sedimenti palustri e torbosi
- Er aree di bonifica e di riporto

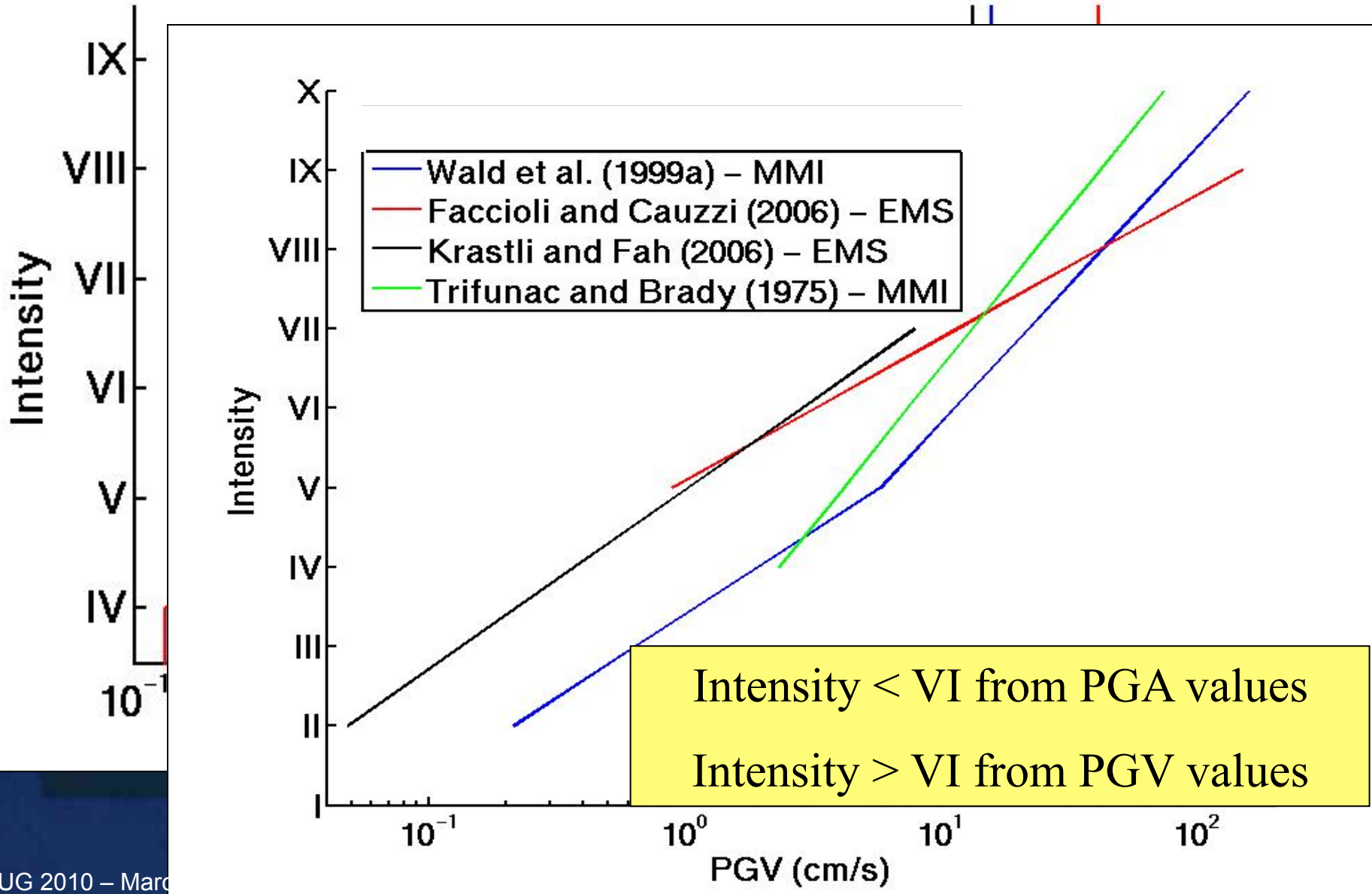
0 12.5 25 50 km

AUG 2010 – March 22-24

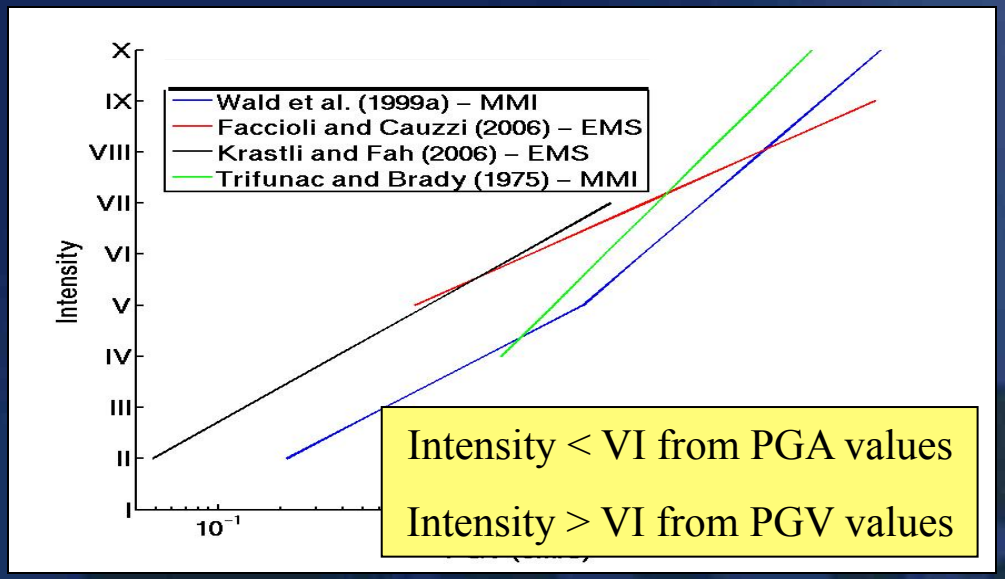
GMPE in Eastern Southern Alps area

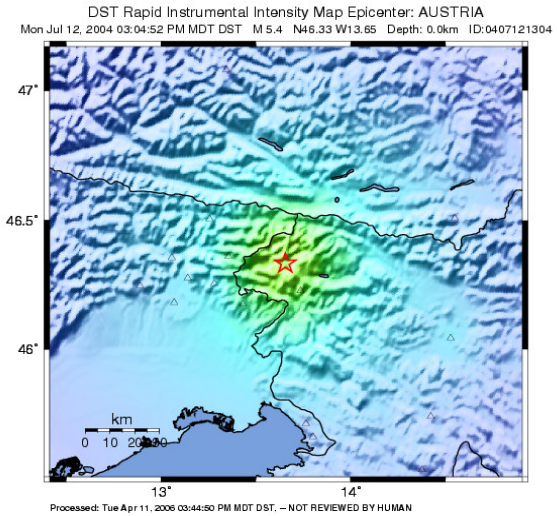
- GMPE computed for PGA, PGV, SA
- Database with signals recorded in the Southeastern Alps
- GMPE in ShakeMap software:
  - Regional GMPE for weak motion (M_L<5.5)
  - Italian/European GMPE (Sabetta and Pugliese, 1996; Ambraseys et al., 2005) for strong motion (M_L>5.5)

The macroseismic intensity

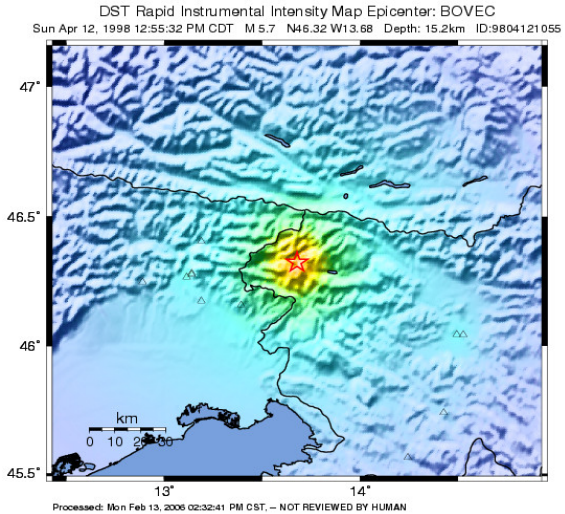


The macroseismic intensity

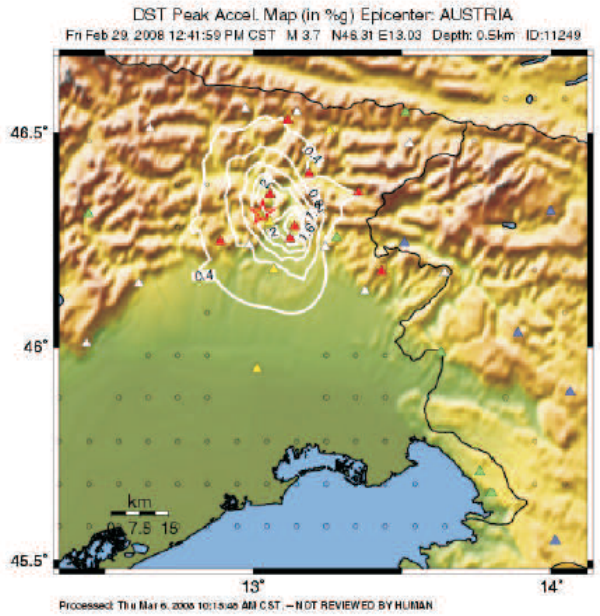


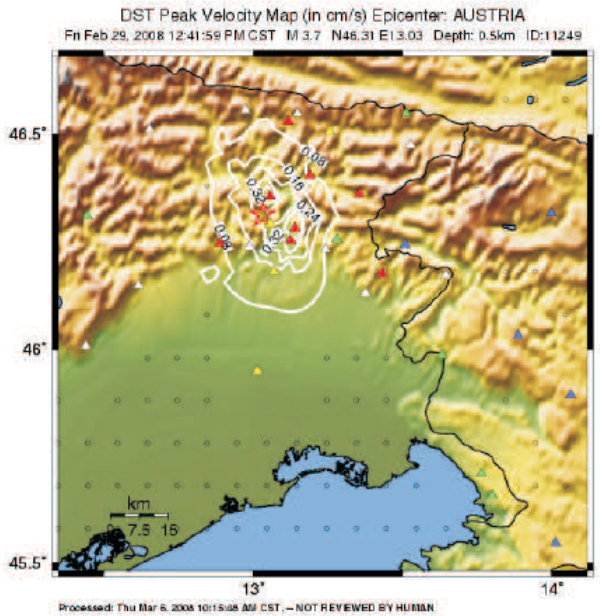


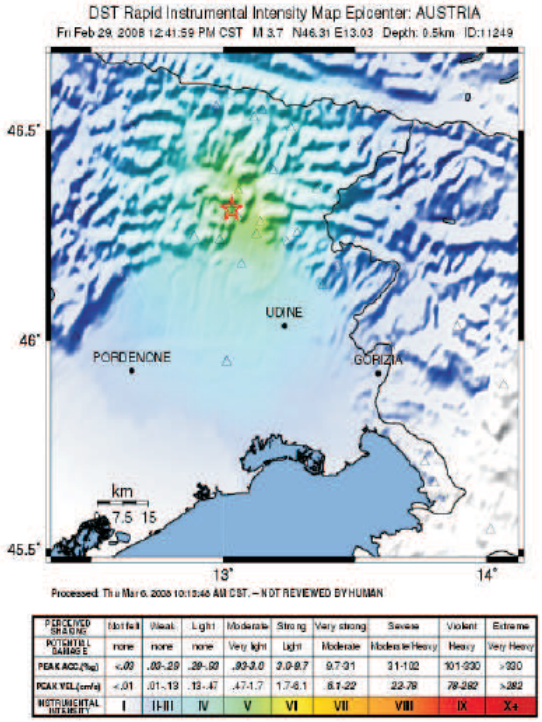
PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE:	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+



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)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/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	II-III	IV	V	VI	VII	VIII	IX	X+



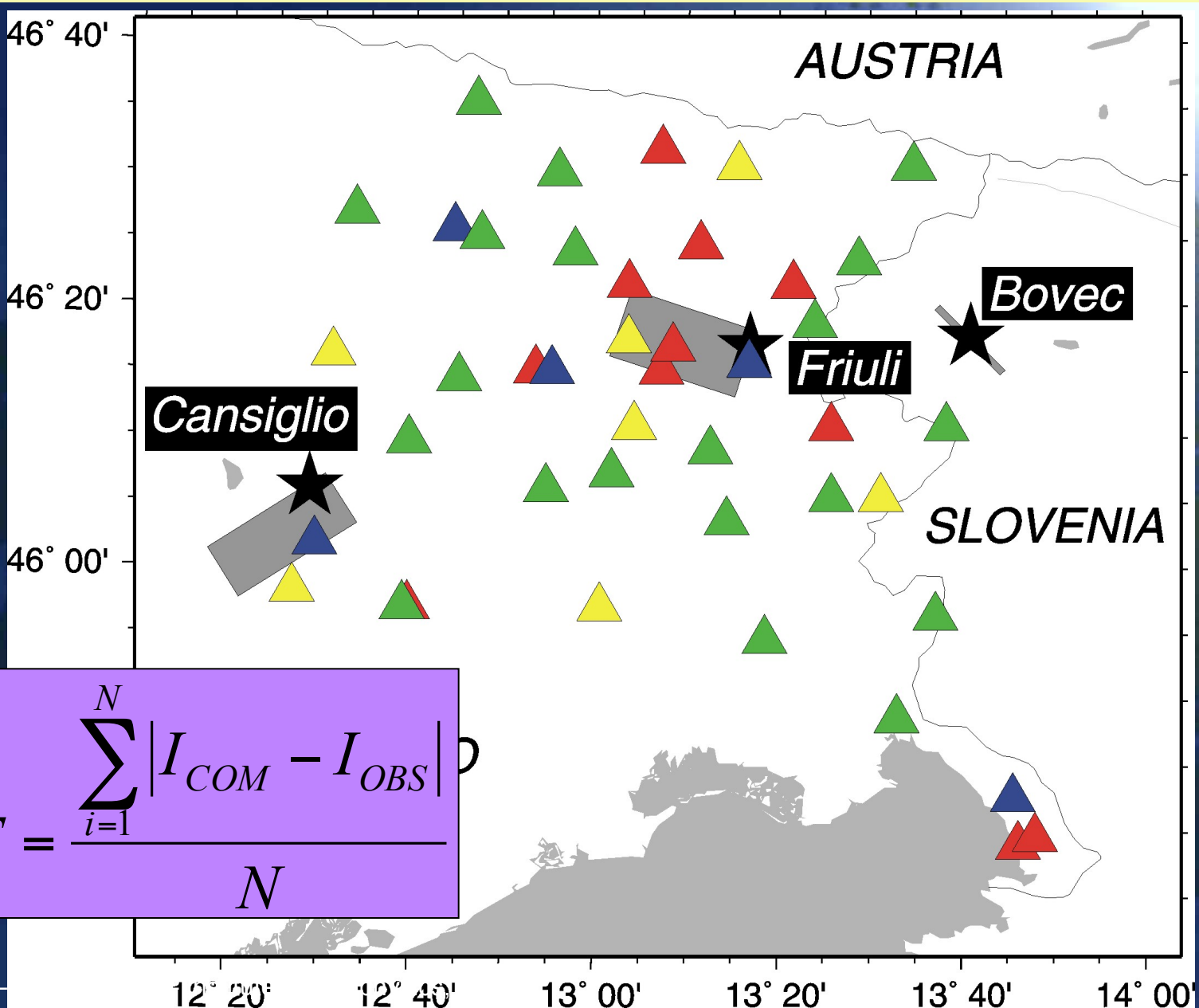




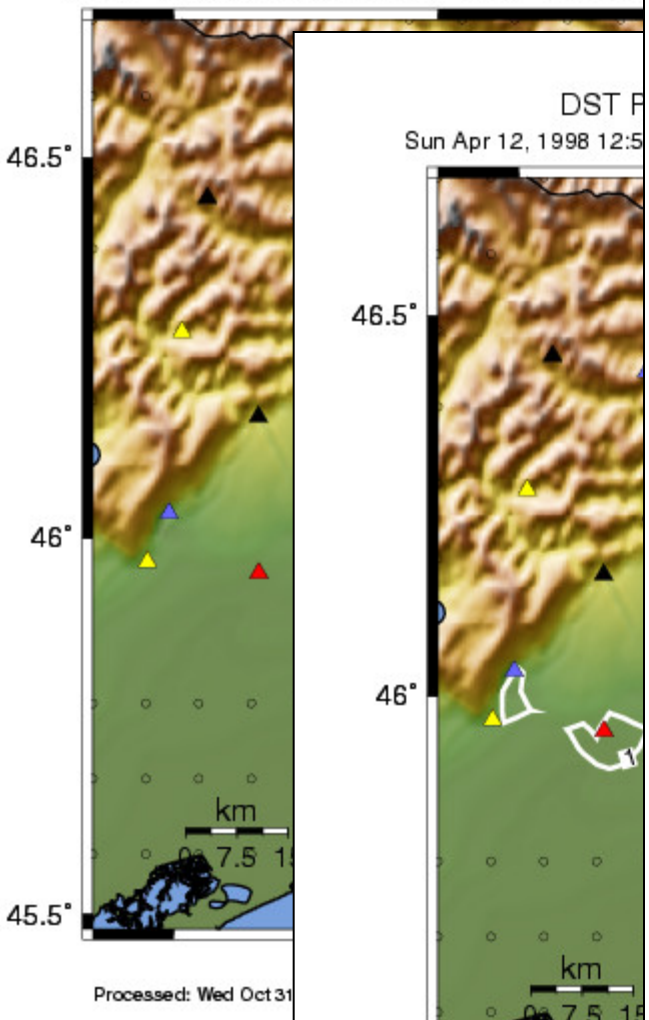
PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<.03	.03-.29	.29-.59	.59-3.0	3.0-9.7	9.7-21	21-102	101-230	>230
PEAK VEL.(cm/s)	<.01	.01-.13	.13-.47	.47-1.7	1.7-6.1	6.1-22	22-79	79-282	>282
INSTRUMENTAL INTENSITY	I	I-III	IV	V	VI	VII	VIII	IX	X+

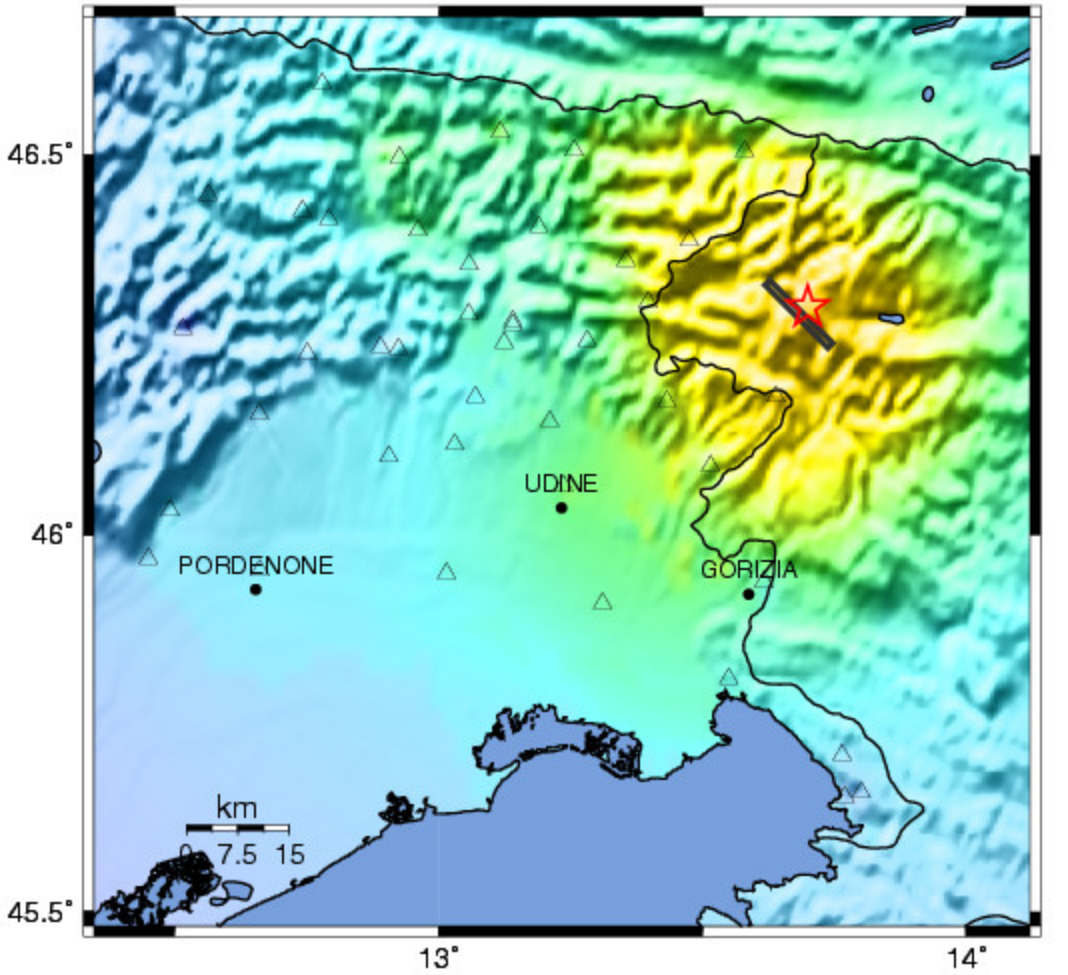
ShakeMaps for PGA (on the left), PGV (in the center) and instrumental intensity (on the right) related to the Trasaghis 2008 earthquake. The networks that recorded the event are RAF (red triangles), RAN (yellow triangles), NEI (green triangles), RSFVG (white triangles) and ARSO (blue triangles).

Validation



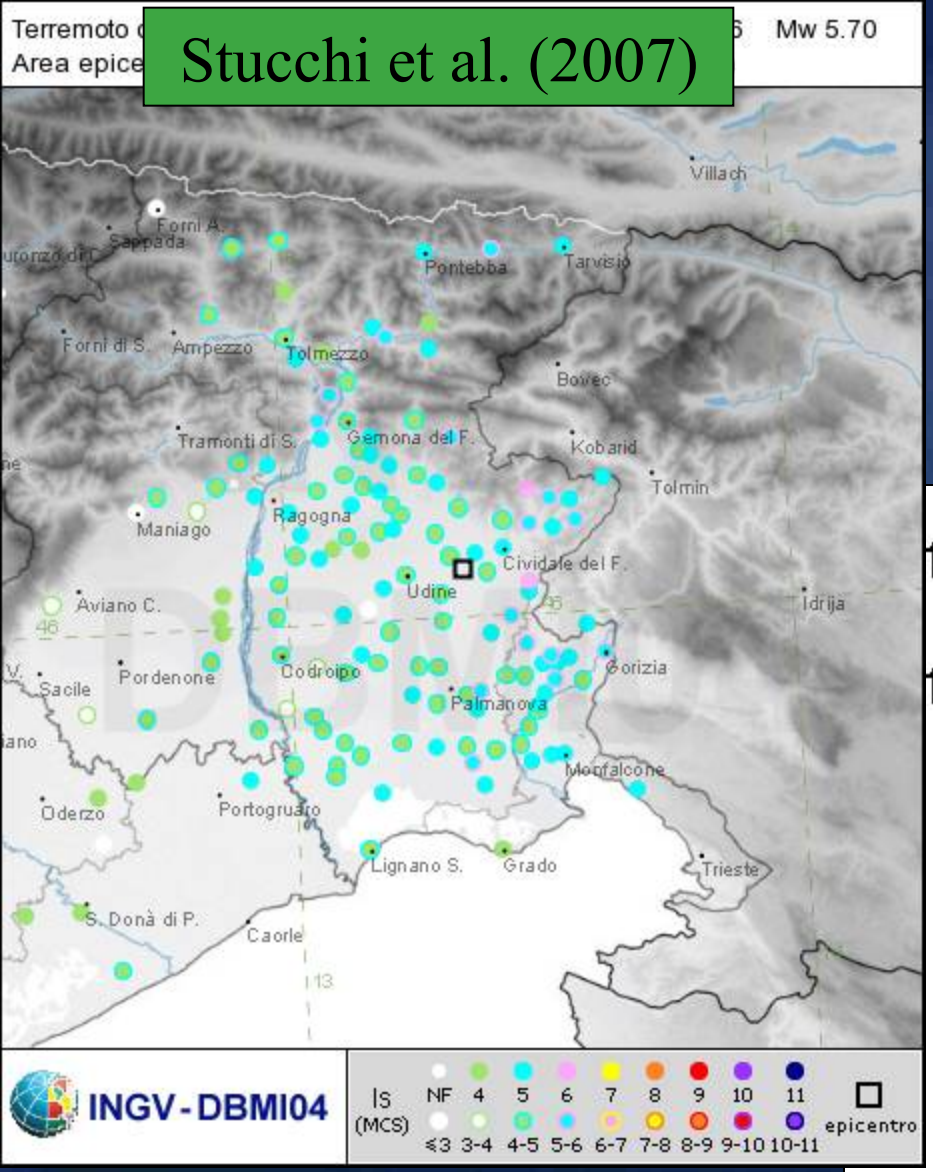
$$MF = \frac{\sum_{i=1}^{N} |I_{COM} - I_{OBS}|}{N}$$





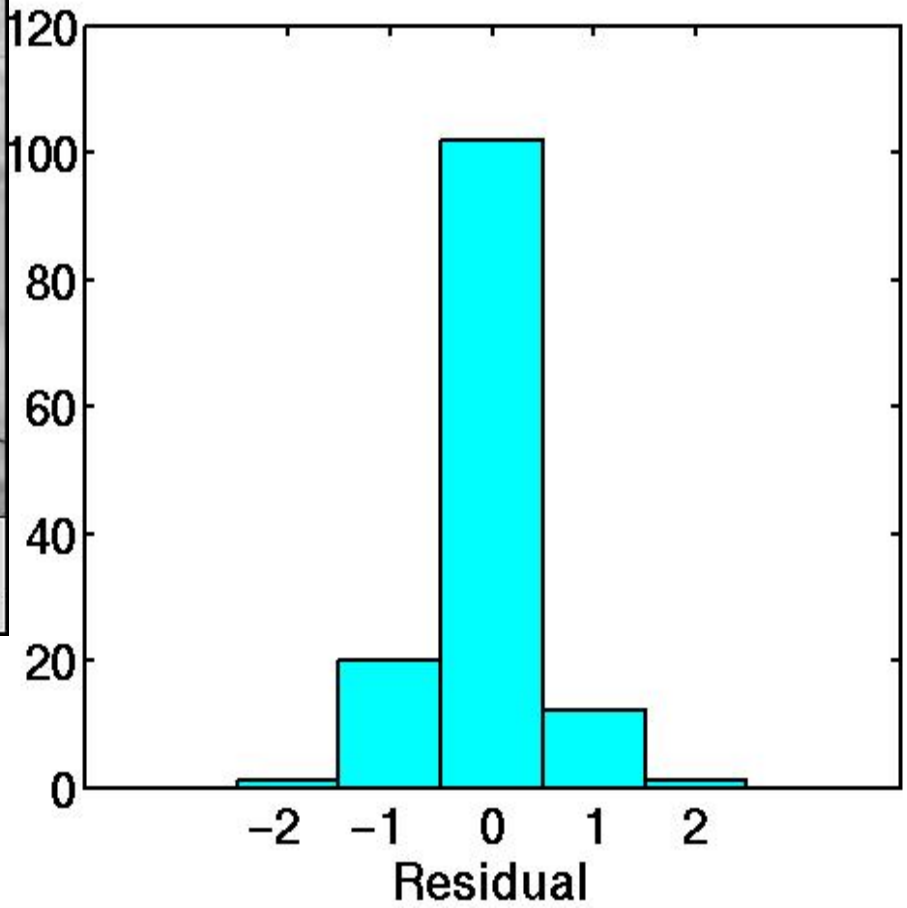
PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.07*	*.07-0.4*	*0.4-0.9*	*0.9-2.0*	*2.0-4.5*	4.5-10	10-23	23-53	>53
PEAK VEL.(cm/s)	<.03	.03-0.2	0.2-0.6	0.6-1.7	1.7-4.7	*4.7-13*	*13-36*	*36-100*	*>100*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

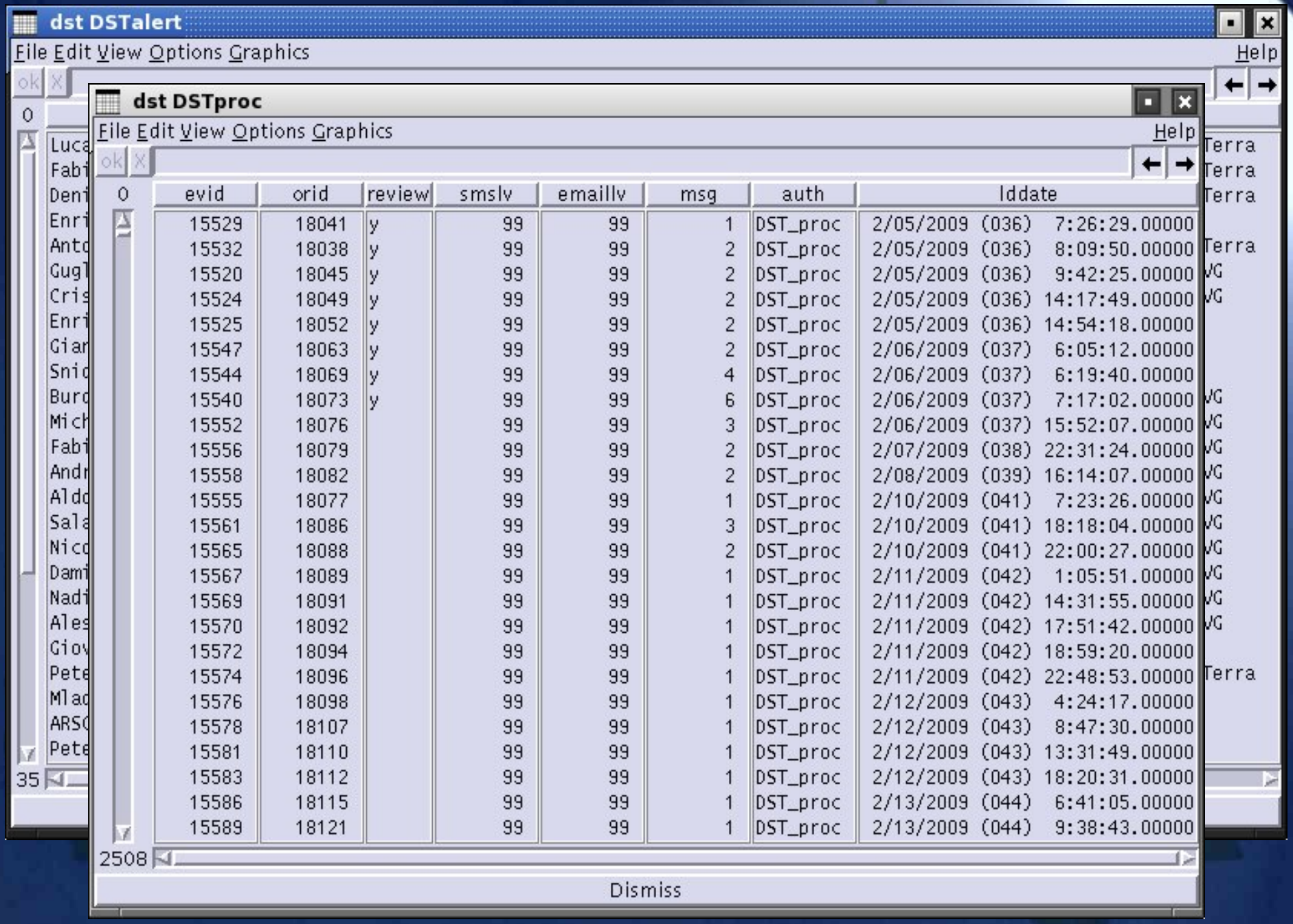
Stucchi et al. (2007)



$$Misfit = \frac{\sum_{i=1}^{N} |I_{COM} - I_{OBS}|}{N} = 0.264$$

N=137





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15520	18045	y	99	99	2	DST_proc	2/05/2009 (036) 9:42:25.00000
15524	18049	y	99	99	2	DST_proc	2/05/2009 (036) 14:17:49.00000
15525	18052	y	99	99	2	DST_proc	2/05/2009 (036) 14:54:18.00000
15547	18063	y	99	99	2	DST_proc	2/06/2009 (037) 6:05:12.00000
15544	18069	y	99	99	4	DST_proc	2/06/2009 (037) 6:19:40.00000
15540	18073	y	99	99	6	DST_proc	2/06/2009 (037) 7:17:02.00000
15552	18076		99	99	3	DST_proc	2/06/2009 (037) 15:52:07.00000
15556	18079		99	99	2	DST_proc	2/07/2009 (038) 22:31:24.00000
15558	18082		99	99	2	DST_proc	2/08/2009 (039) 16:14:07.00000
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15572	18094		99	99	1	DST_proc	2/11/2009 (042) 18:59:20.00000
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15576	18098		99	99	1	DST_proc	2/12/2009 (043) 4:24:17.00000
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15581	18110		99	99	1	DST_proc	2/12/2009 (043) 13:31:49.00000
15583	18112		99	99	1	DST_proc	2/12/2009 (043) 18:20:31.00000
15586	18115		99	99	1	DST_proc	2/13/2009 (044) 6:41:05.00000
15589	18121		99	99	1	DST_proc	2/13/2009 (044) 9:38:43.00000

sta	chan	filter			dist	azi	PGA	PGV	PSA03	PSA01	PSA30	Arias	Housner	time	
TRI	HHN	Ba	0.2	20	43	174	0.621	0.013	0.496	0.123	0.009	0.633	0.060	04/05/2009	20:21:11
JAVS	HHN	Ba	0.2	20	43	205	0.211	0.014	0.565	0.169	0.010	0.104	0.060	04/05/2009	20:21:15
CIMO	HHE	Ba	0.2	20	4	194	0.131	0.006	0.209	0.069	0.011	0.032	0.025	04/05/2009	20:21:13
CIMO	HLE	Ba	0.2	20	4	194	0.128	0.006	0.205	0.069	0.011	0.030	0.025	04/05/2009	20:21:13
POLC	HHZ	Ba	0.2	20	7	163	0.221	0.017	0.494	0.208	0.011	0.201	0.072	04/05/2009	20:21:09
JAVS	HHZ	Ba	0.2	20	43	205	0.141	0.012	0.418	0.144	0.011	0.062	0.055	04/05/2009	20:21:15
JAVS	HHE	Ba	0.2	20	43	205	0.258	0.015	0.922	0.214	0.013	0.148	0.085	04/05/2009	20:21:15
CIMO	HHN	Ba	0.2	20	4	194	0.117	0.006	0.219	0.108	0.014	0.032	0.027	04/05/2009	20:21:13
CIMO	HLN	Ba	0.2	20	4	194	0.115	0.006	0.221	0.110	0.015	0.031	0.028	04/05/2009	20:21:13
SKDS	HGE	Ba	0.2	20	51	176	0.420	0.027	0.691	0.159	0.015	0.264	0.073	04/05/2009	20:21:11
SKDS	HHE	Ba	0.2	20	51	176	0.463	0.016	0.718	0.163	0.015	0.321	0.076	04/05/2009	20:21:11
TRI	HHZ	Ba	0.2	20	43	174	2.064	0.026	0.932	0.111	0.016	8.280	0.080	04/05/2009	20:21:11
VINO	HHE	Ba	0.2	20	23	204	0.139	0.012	0.615	0.203	0.016	0.073	0.058	04/05/2009	20:21:15
TRI	HHE	Ba	0.2	20	43	174	1.256	0.023	0.632	0.213	0.016	2.232	0.085	04/05/2009	20:21:11
DST2	HGN	Ba	0.2	20	45	172	0.546	0.034	1.411	0.402	0.017	0.459	0.134	04/05/2009	20:21:11
DST2	HHN	Ba	0.2	20	45	172	0.538	0.033	1.413	0.402	0.017	0.482	0.135	04/05/2009	20:21:11
SKDS	HGZ	Ba	0.2	20	51	176	0.449	0.018	0.676	0.130	0.017	0.232	0.070	04/05/2009	20:21:11
SKDS	HHN	Ba	0.2	20	51	176	0.505	0.022	0.881	0.133	0.017	0.374	0.076	04/05/2009	20:21:11
SKDS	HGN	Ba	0.2	20	51	176	0.466	0.020	0.847	0.131	0.017	0.299	0.073	04/05/2009	20:21:11
KNDS	HHN	Ba	0.2	20	57	199	0.349	0.025	0.923	0.336	0.017	0.207	0.096	04/05/2009	20:21:14
SKDS	HHZ	Ba	0.2	20	51	176	0.466	0.016	0.684	0.131	0.018	0.254	0.071	04/05/2009	20:21:11
POLC	HHE	Ba	0.2	20	7	163	0.414	0.027	1.297	0.519	0.018	0.559	0.149	04/05/2009	20:21:09
DST2	HGZ	Ba	0.2	20	45	172	0.356	0.019	0.963	0.259	0.019	0.229	0.096	04/05/2009	20:21:11
DST2	HHZ	Ba	0.2	20	45	172	0.360	0.021	0.983	0.259	0.019	0.235	0.096	04/05/2009	20:21:11
CIMO	HHZ	Ba	0.2	20	4	194	0.105	0.006	0.181	0.068	0.020	0.030	0.031	04/05/2009	20:21:13
CIMO	HLZ	Ba	0.2	20	4	194	0.102	0.006	0.176	0.068	0.020	0.028	0.031	04/05/2009	20:21:13
KNDS	HHZ	Ba	0.2	20	57	199	0.176	0.019	0.466	0.223	0.020	0.065	0.069	04/05/2009	20:21:14
PALA	HHZ	Ba	0.2	20	16	194	0.179	0.014	0.418	0.170	0.021	0.083	0.069	04/05/2009	20:21:13
PALA	HGZ	Ba	0.2	20	16	194	0.177	0.015	0.417	0.170	0.021	0.081	0.069	04/05/2009	20:21:13
POLC	HHN	Ba	0.2	20	7	163	0.727	0.043	1.238	0.369	0.023	0.892	0.178	04/05/2009	20:21:09
VINO	HHN	Ba	0.2	20	23	204	0.229	0.017	0.632	0.278	0.023	0.089	0.078	04/05/2009	20:21:15
VINO	HHZ	Ba	0.2	20	23	204	0.137	0.013	0.294	0.142	0.024	0.065	0.052	04/05/2009	20:21:15
DST2	HHE	Ba	0.2	20	45	172	0.546	0.034	1.564	0.534	0.026	0.561	0.161	04/05/2009	20:21:11
DST2	HGE	Ba	0.2	20	45	172	0.536	0.036	1.540	0.534	0.026	0.537	0.160	04/05/2009	20:21:11