Modernizing the ISC Procedures: Model Evaluation for the Italian region

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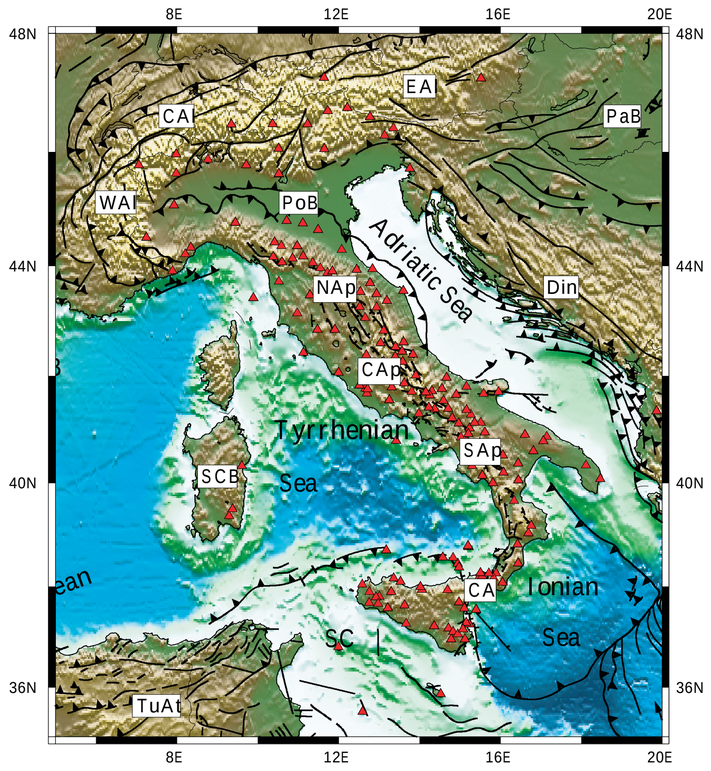


Figure 1. Structural sketch of the Italian region, including the main geographical and tectonic references. Red triangles correspond to locations of the Italian National Seismic Network stations by INGV (Istituto Nazionale di Geofisica e Vulcanologia).

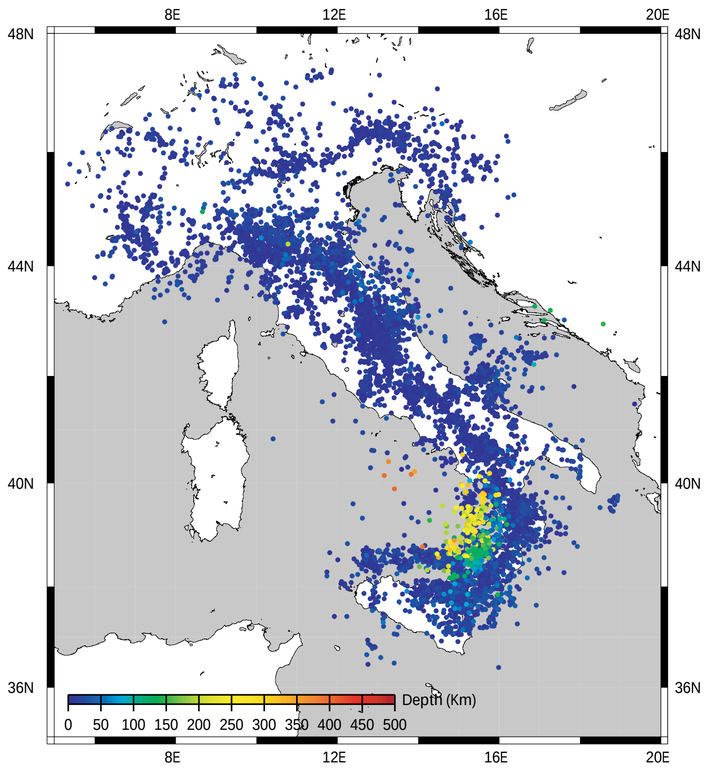


Figure 2. Distribution of italian seismicity according to CSI catalogue 1981-2002 (http://www.ingv.it/CSI). Hypocentral locations have been obtained by using P- and S-wave arrival times from the INGV national and several regional permanent seismic networks.

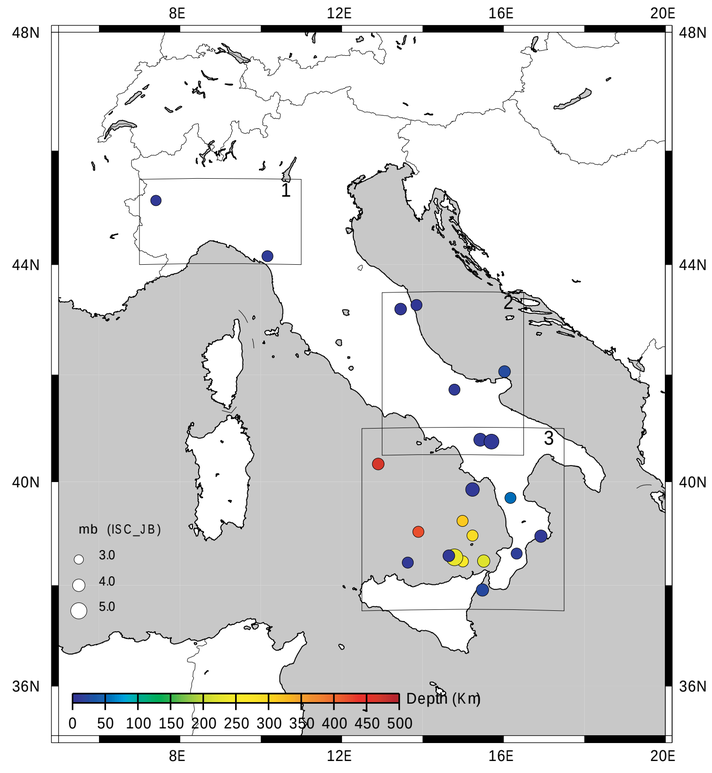


Figure 3. Hypocentral locations of the 23 moderate magnitude earthquakes reported by ISC for the Italian Peninsula in the period January-October 2004. Location according to JB reference model. Most events occur NW of the Calabrian Arc (CA), in the Southern Tyrrhenian Subduction Zone.
3.3<mb<5.4
0<depth<464 km

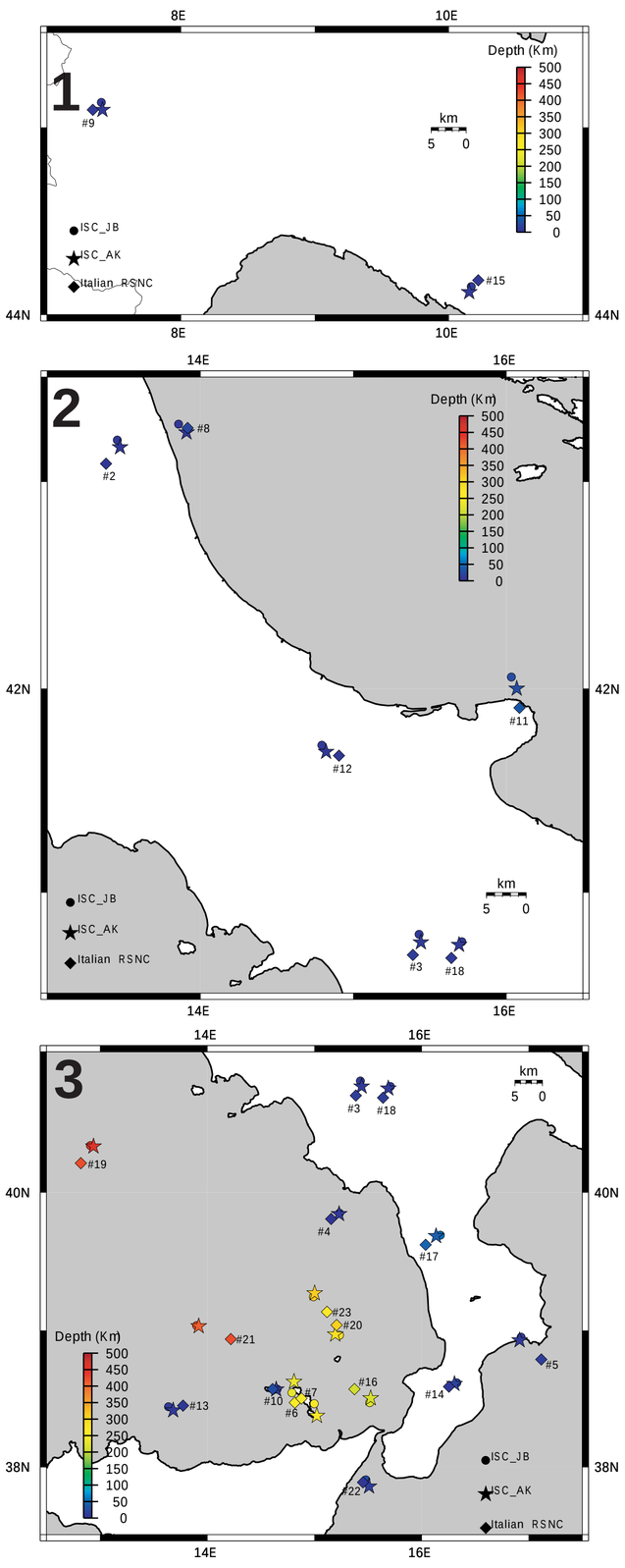


Figure 4. Plots correspond to the three inset boxes in Figure 3. Hypocentral parameters from ISC and INGV are listed in Table 1 and plotted here with different symbols. We indicate locations with Jeffreys and Bullen reference model by JB, those with ak135 model by AK. INGV locations are those reported by the Seismic Bulletin of the Italian National Central Seismic Network, published on-line fortnightly since 2002: http://www.ingv.it/%7eroma/reti/rms/bollettino/index.php
Event number is plotted on map at INGV locations according to Table 1. Symbols are colored by event depth. There is no apparent systematic shift between JB and AK locations.

#	mb	lat JB	lon JB	depth JB (km)	lat AK	lon AK	depth AK (km)	Gap ISC	lat INGV	lon INGV	depth INGV (km)	Gap INGV	ep diff JB-AK (km)	ep diff JB INGV (km)	ep diff AK-INGV (km)	dep diff JB-AK (km)	dep diff JB-INGV (km)	dep diff AK-INGV (km)
1	3,5	44,53	12,466	5	44,516	12,47	5	41	44,507	12,63	0	132	1,48	13,29	12,9	0	4,97	4,97
2	3,8	43,199	13,458	3,5	43,165	13,48	3,5	33	43,087	13,38	14.24	187	4	13,71	11,18	0	0,1	0,1
3	4,1	40,792	15,43	10,3	40,754	15,44	10,3	42	40,69	15,39	12,9	71	4,39	11,84	8,19	0	2,6	2,6
4	4,4	39,85	15,235	10	39,843	15,23	10	28	39,809	15,16	2,4	129	0,83	7,67	6,95	0	7,65	7,65
5	4	38,952	16,931	10	38,929	16,91	10	98	38,791	17,12	13,2	203	2,83	23,07	22,03	0	3,2	3,2
6	3,7	38,466	15	258,4	38,378	15,02	268,5	41	38,475	14,82	256,8	88	9,93	14,25	19,27	10,1	1,6	11,7
7	5,4	38,547	14,792	228,6	38,626	14,81	230,6	19	38,5	14,88	230,6	294	8,89	8,2	14,5	2	11,3	9,3
8	3,5	43,276	13,857	5	43,236	13,91	5	37	43,257	13,92	19,8	174	6,01	5,08	2,4	0	14,84	14,84
9	3,3	45,132	7,407	10	45,093	7,414	10	22	45,092	7,343	9,7	63	4,36	6,67	5,55	0	0,29	0,29
10	3,8	38,572	14,654	9,9	38,571	14,64	9,9	47	38,574	14,61	24	77	0,87	3,49	2,62	0	14,08	14,08
11	3,8	42,057	16,033	24,9	42,001	16,07	24,9	25	41,907	16,09	33,5	199	6,84	17,17	10,47	0	8,61	8,61
12	3,7	41,724	14,794	10,1	41,692	14,82	6,5	29	41,674	14,91	7	98	4,18	10,27	6,79	3,6	3,09	0,51
13	3,6	38,443	13,637	9,9	38,418	13,68	9,4	58	38,452	13,77	7,5	90	4,46	10,63	7,98	0,5	2,44	1,94
14	3,7	38,619	16,331	14,3	38,611	16,31	16,6	88	38,591	16,26	4,3	168	2,09	6,64	4,56	2,3	9,99	12,29
15	3,7	44,151	10,169	12,1	44,121	10,15	8,4	50	44,185	10,22	8,9	73	3,56	5,43	8,77	3,7	3,24	0,46
16	3,9	38,474	15,517	219,7	38,507	15,52	213,6	30	38,572	15,38	208,6	63	3,69	15,53	13,69	6,1	11,1	5
17	3,7	39,691	16,176	52,6	39,685	16,14	40,9	51	39,622	16,04	45,9	127	3,23	13,2	10,33	11,7	6,69	5,01
18	4,7	40,755	15,71	10	40,74	15,69	10	33	40,675	15,64	10,1	67	2,27	10,36	8,16	0	0,14	0,14
19	3,8	40,334	12,911	464,3	40,328	12,94	460	50	40,209	12,82	417,4	137	2,13	15,48	16,02	4,3	46,87	42,57
20	3,7	38,966	15,235	289,8	38,972	15,19	284,8	31	39,041	15,21	305	125	3,26	8,6	7,77	5	15,2	20,2
21	3,7	39,036	13,902	418,1	39,033	13,92	407,1	25	38,939	14,22	419,3	94	1,42	26,92	25,54	11	1,23	12,23
22	3,9	37,905	15,481	21,3	37,856	15,51	13,2	91	37,887	15,45	4,8	127	5,95	2,98	5,66	8,1	16,53	8,43
23	3,6	39,247	14,992	312,7	39,272	15	309,5	63	39,136	15,12	264,6	151	2,94	15,64	17,49	3,2	48,1	44,9

Table 1. Hypocentral parameters and differences between locations.

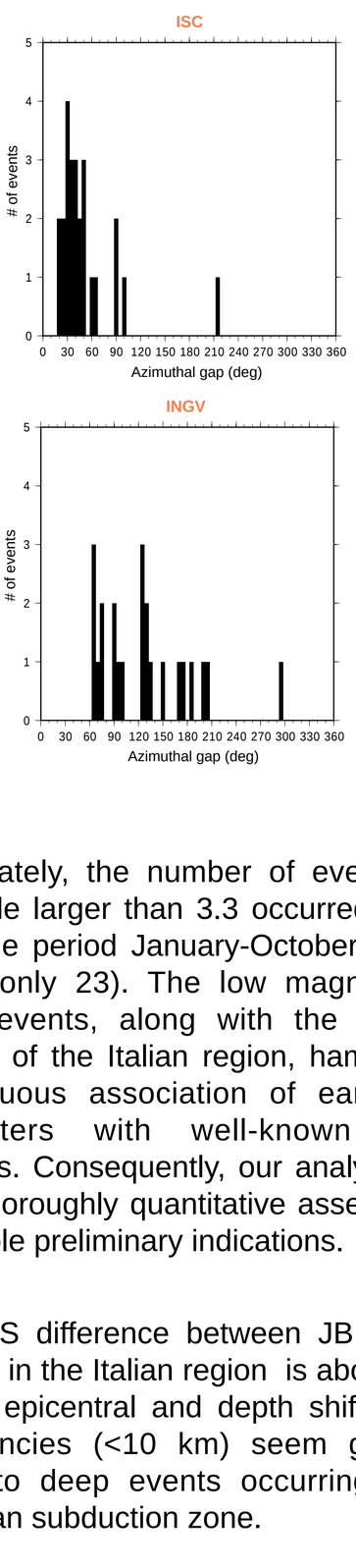
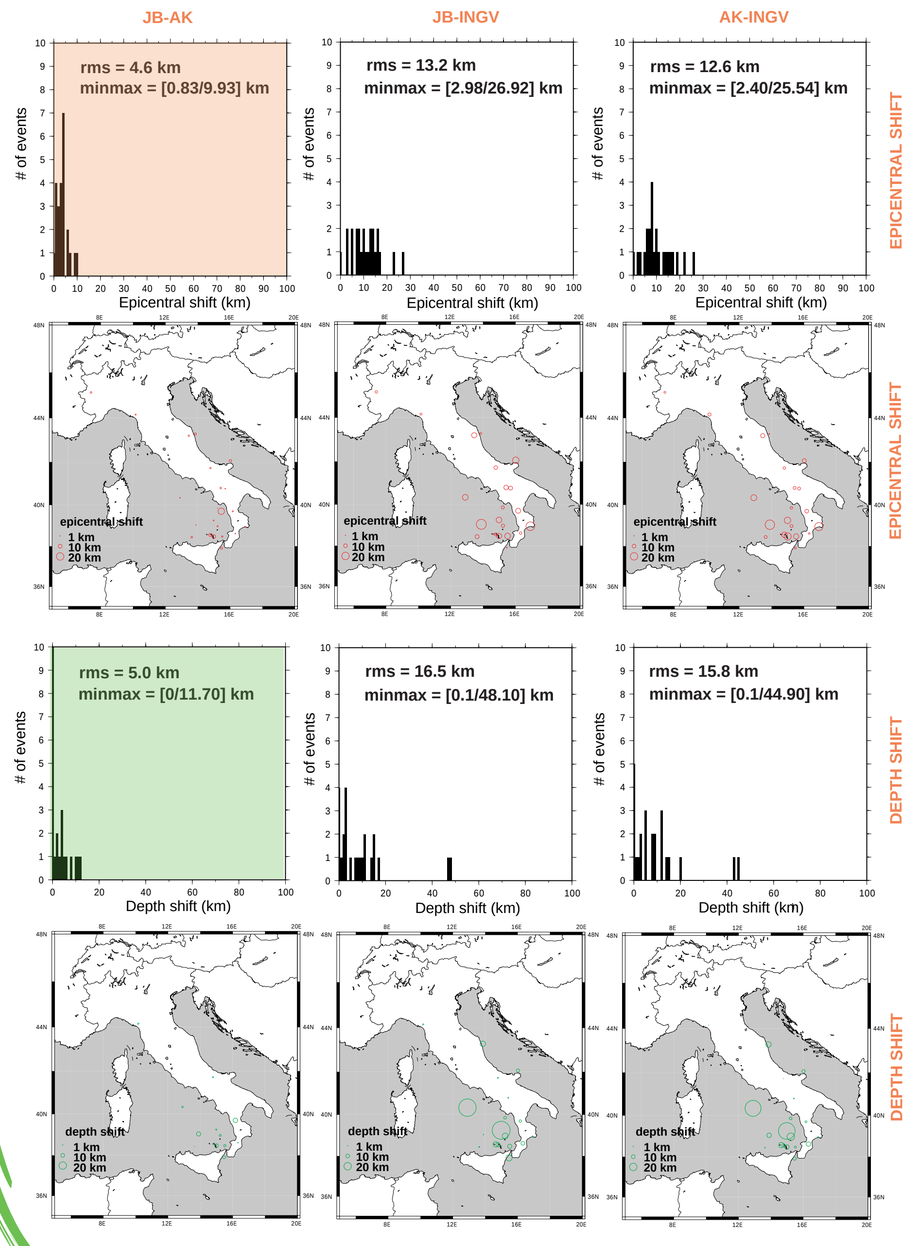


Figure 5. Comparison of different locations through histograms and geographical distribution of epicentral shifts. Root mean square's difference, minimum and maximum values are given for each case. There seem to be no apparent or significant systematic trend in hypocentral parameters shifts between different locations for this scarce dataset.



Unfortunately, the number of events with magnitude larger than 3.3 occurred in Italy during the period January-October 2004 is scarce (only 23). The low magnitude of these events, along with the complex tectonics of the Italian region, hampers an unambiguous association of earthquake hypocenters with well-known active structures. Consequently, our analysis lead to non-thoroughly quantitative assessments and simple preliminary indications.

1) RMS difference between JB and AK locations in the Italian region is about 5 km, for both epicentral and depth shift. Larger discrepancies (<10 km) seem generally related to deep events occurring in the Tyrrhenian subduction zone.

2) Larger RMS differences (about 13-16 km) between ISC (JB or AK) and INGV locations are mainly due to earthquakes with a poor azimuthal and distance coverage with respect to the Italian seismic network.

3) At this stage, the discrepancy between the ISC and the Italian bulletin locations seems negligibly affected by the use of either (JB or AK) reference models.