



Abstract

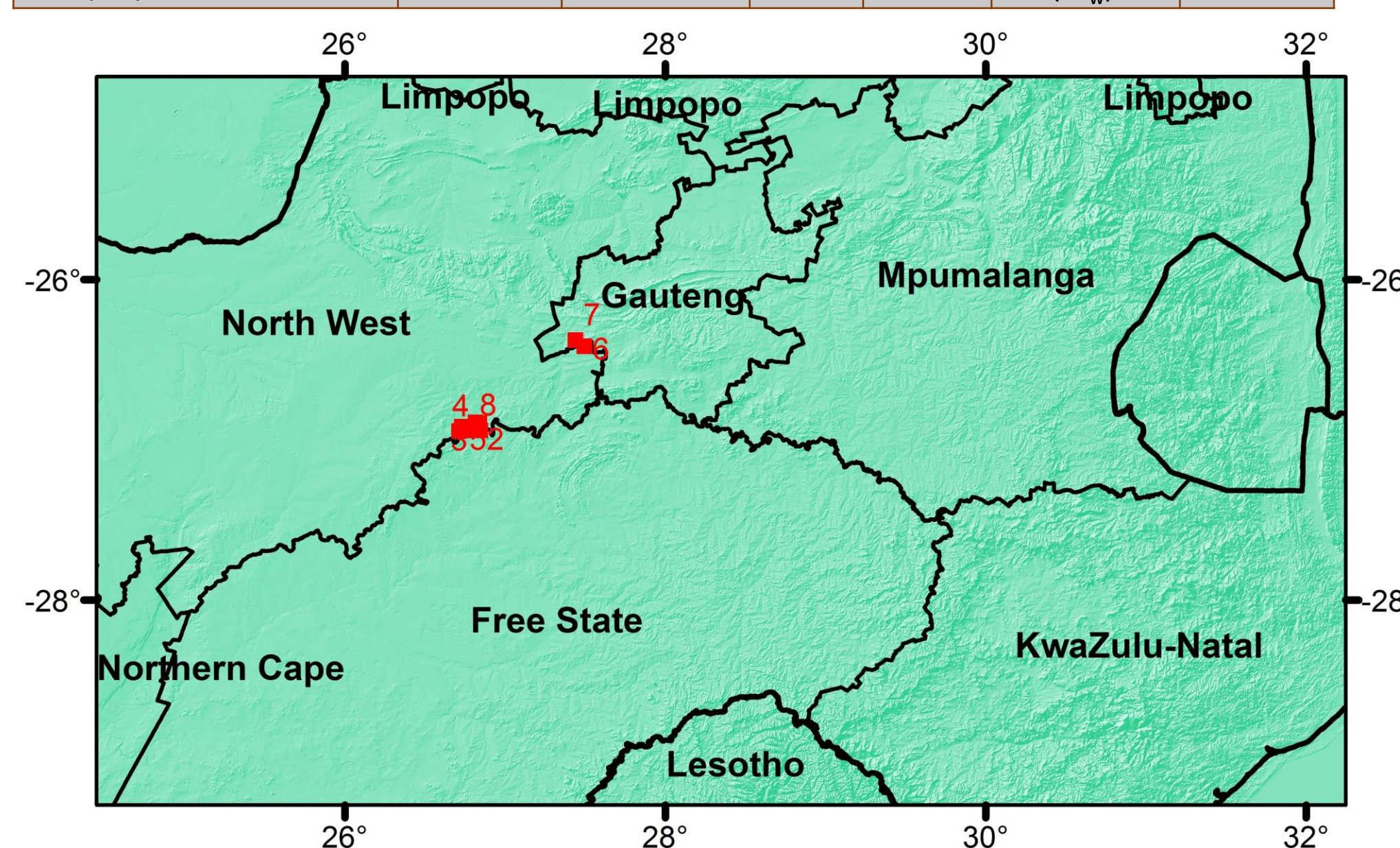
In an effort to improve the velocity models used in the calculation of travel time corrections for regional phases, well-located earthquakes are being relocated and classified as ground truth (GT). The events were selected from the catalogue of South African events and were prepared by first reassessing their source parameters using available collected phase data. The first step in identifying possible GT events was to preselect events that were going to be further analysed to see if they satisfy the GT_{95%} criteria. A set of eight events recorded by more than five stations located within a distance of 150 km of the event epicenter was identified. Using the ISC location algorithm, iLOC, and a 3D global velocity model made compliant with the Regional Seismic Travel Times (RSTT) parameterization, the eight events were further analysed. Results of this analysis include results of Ground Truth (GT) candidate test according to preset selection criteria. Solutions of two of the eight preselected events were found to satisfy the conditions for GT_{95%} candidacy whilst four events satisfied the criteria for GT_{90%} candidacy. The P wave path coverage for the two identified GT_{95%} events shows that both events were well recorded by 106 and 542 stations respectively, which were well distributed azimuthally. It is hoped that these GT_{95%} events are going to be useful in the improvement of the RSTT models for our region as well as the improvement of local velocity models used in local analysis software packages.

Introduction

In order to improve the accuracy of earthquake location, an accurate velocity model is required (Bondár et al., 2004). To be able to effectively test and validate the accuracy velocity models, there is a need for a high quality data set of earthquakes and explosions referred to as ground truth (GT) event data. According to Bondár et al. (2004), GT represents events with exactly known locations, depth and origin time. The criteria for assigning GTX events created by Bondár et al. (2004) was used for the events in South Africa. For each event, it was required that atleast five recording stations located within a distance of 150 km of the event epicenter.

Preselected events with at least five stations within a radius of 150 km.

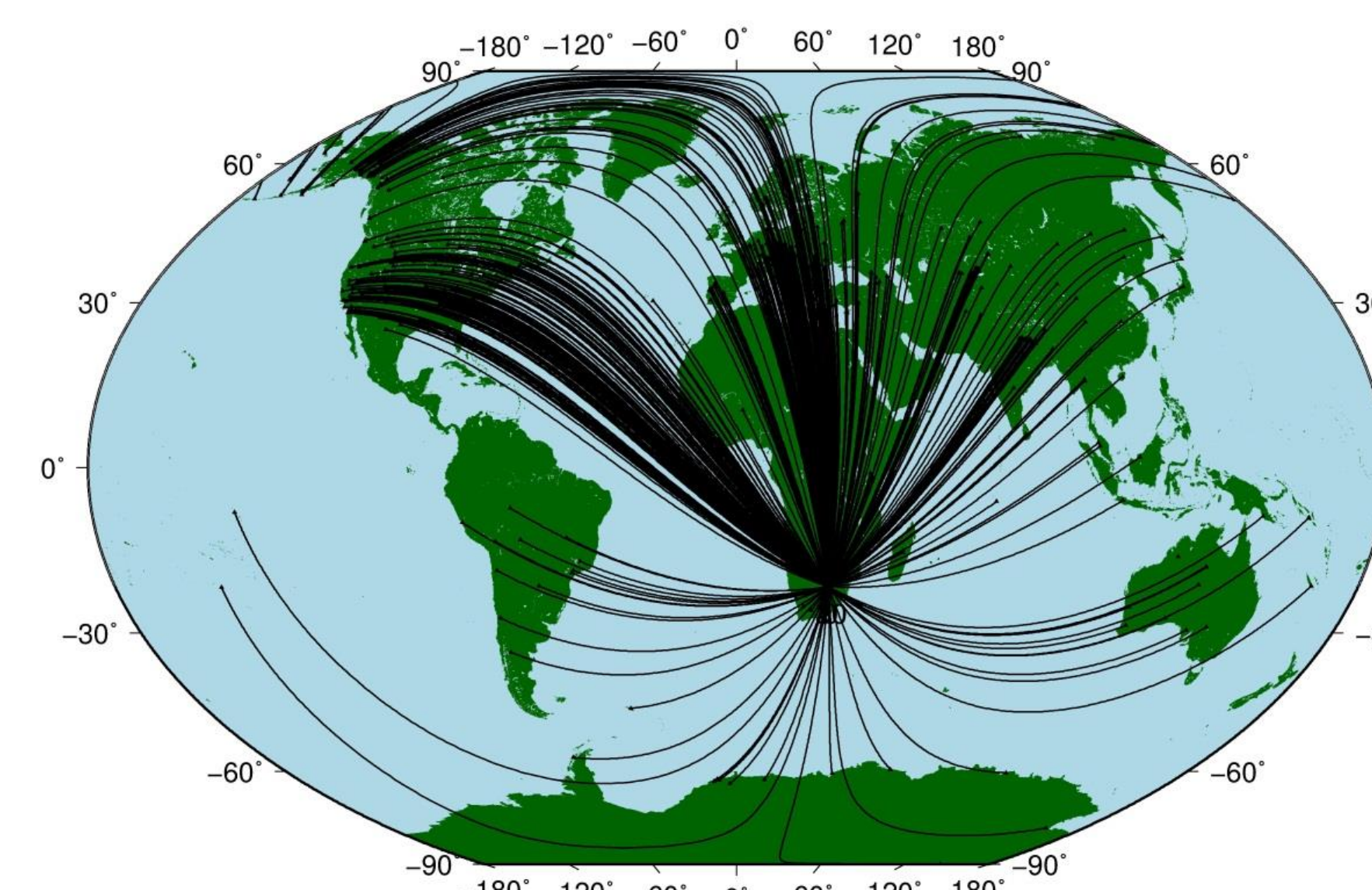
Event Origin Time	Epicentre		RMS	Depth (km)	Magnitude, (Type), error	No of stations
	Latitude	Longitude				
1986/11/13 11:11:16.84	-26.9404	26.8437	1.27	0.3	5.1 (M _s) ±0.5	37
1987/07/30 12:46:29.55	-26.8971	26.8384	2.33	7.2	4.2 (M _s) ±0.2	43
1987/09/30 07:37:37.91	-26.8900	26.8150	1.58	8.0	5.0 (M _s) ±0.2	60
1991/11/03 18:28:56.45	-26.9443	26.7118	1.42	1.4	4.3 (M _s) ±0.2	92
2009/03/16 14:05:43.78	-26.9165	26.7290	1.13	7.0	5.1 (M _s) ±0.4	106
2010/06/14 11:51:57.34	-26.4162	27.4949	1.37	6.7	5.0 (M _s) ±0.1	138
2010/11/12 22:53:47.40	-26.3765	27.4390	1.58	12.5	4.6 (M _s) ±0.6	63
2014/08/05 10:22:33.93	-26.9397	26.7923	1.43	4.2	5.5 (M _w)	542



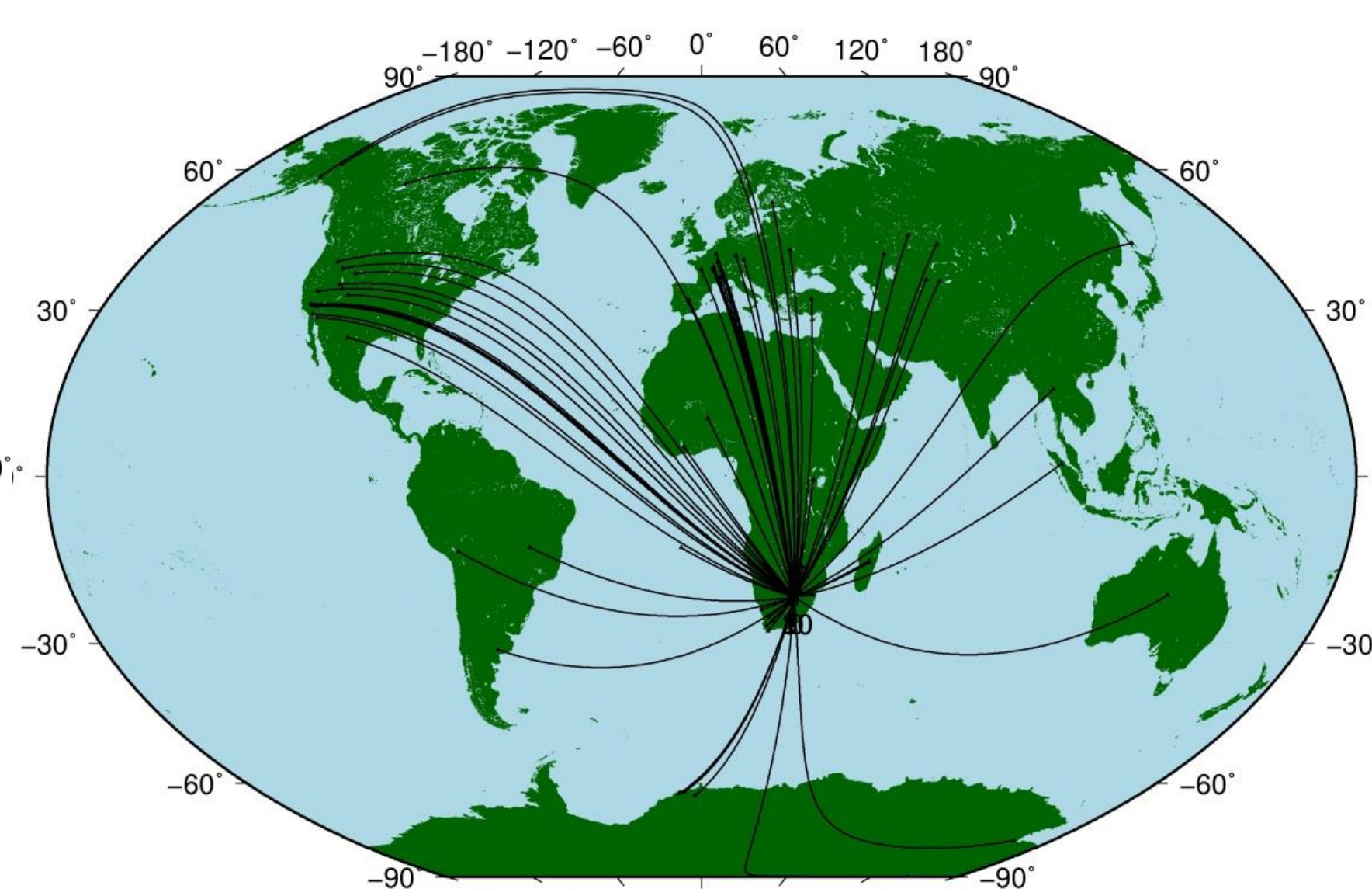
Methodologies and Criteria for assigning GTX

The iLOC software was implemented to relocate the events utilizing both the Neighborhood Algorithm and the linearized inversion algorithm to obtain the final solution and formal uncertainties. Accurately P and S phases were manually picked and the location was performed using a 3D global velocity model made compliant with the Regional Seismic Travel Times (RSTT) parameterization. The output of the location process with iLOC includes results of a Ground Truth (GT) candidate test according to the Bondár and McLaughlin (2009); Bondár et al. (2004) selection criteria.

Network	Distance Range (degrees)	Primary Azimuthal Gap	Secondary Azimuthal Gap	Number of Stations within Specified Distance			GT Level
				Between 250 km and 1000 km	< 250 km	< 30 km	
Local	0°-2.5°	110°	160°	-	10	1	GT _{95%}
Near Regional	2.5°-10°	-	120°	10	-	-	GT _{90%}
Teleseismic	28°-91°	-	120°	-	-	-	GT _{90%}



5 August 2014 Orkney GT_{95%} event



16 March 2009 GT_{95%} event

The P wave ray path coverage for the two identified GT_{95%} events are shown above. Both events were well recorded by 106 and 542 stations respectively, which were well distributed azimuthally. However, as expected there is better coverage to the north than in any other direction.

Results of the GTX calculations

Results obtained after the relocation of pre-selected events using the iLOC software. Events highlighted in green satisfy the criteria (Table 7) for GT_{95%} events, whilst those in yellow satisfy the criteria (Table 6) for GT_{90%} events.

Event	Network (Local L, Near Regional NR)	Velocity Model	Primary Azimuthal GAP	Secondary Azimuthal GAP	Network Metric	Number of Stations within Specified Distance, D in km			GT Level
						150 ≤ D ≤ 1000	D < 150	D < 10	
19861113	L NR	RSTT	89.0	235.6	0.298	10	5	0	-
19870730	L NR	RSTT	108.0	323.0	0.341	9	3	1	-
19870930	L NR	RSTT	59.0	229.9	0.239	9	4	1	-
19911103	L NR	RSTT	33.0	203.8	0.134	10	4	1	-
20090316	L	RSTT	32.0	147.1	0.259	7	2	5	5
20100614	L NR	RSTT	50.0	182.7	0.448	10	6	0	-
20101112	L NR	RSTT	44.0	205.5	0.331	13	7	1	-
20140805	L	RSTT	23	143.1	0.295	-	28	5	5

Conclusions

Two events satisfied the conditions for GT_{95%} candidacy whilst four events satisfied the criteria for GT_{90%} candidacy. Parameters of the identified GT_{95%} events are going to be contributed to the ISC GT event database. It is hoped that these and other events in the database are going to be useful in the improvement of the RSTT models for our region as well as the improvement of local velocity models used in our own analysis software packages.

References

- Bondár I., S.C. Myers, E.R. Engdahl, and E.A. Bergman (2004). Epicentre accuracy based on seismic network criteria, *Geophysics Journal International*, 156, 483–496.
- Bondár I. and K.L. McLaughlin (2009). A new ground truth data set for seismic studies, *Geophysical Research Letters*, 80, 465–472.