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LAMPIRAN

Lampiran 1. Data Katalog BMKG

```
The Agency for Meteorology Climatology and Geophysics (BMKG )
Indonesia Tsunami Eary Warning System (InaTEWS)
---------------------------------------------------------------------
Format arrival2 results for:
Latitude : -11 until -4
Longitude: 105 until 109
Depth    : 1 until 1000
Magnitude: 1 until 9.5
Time     : 2017/01/01 until 2017/12/31
.................................................................................
Event:
Public ID            bmg2017zonb
Preferred Origin ID    Origin#20171231075733.736596.24330
Preferred Magnitude ID Magnitude#20171231075738.302496.24341
Description
region name: Java, Indonesia
Creation time          2017-12-30 17:00:26

Origin:
Public ID              Origin#20171231075733.736596.24330
Date                   2017-12-30
Time                   16:53:40.094  +/-    1.7 s
Latitude                -8.08 deg  +/-   11 km
Longitude              107.68 deg  +/-    5 km
Depth                     20 km   +/-   12 km
Agency                 BMKG
Author                 scolv@sc-gui-prod.tews
Mode                   manual
Status                 confirmed
Creation time          2017-12-31 07:57:33
Residual RMS              0.88 s
Azimuthal gap             238 deg


2 Network magnitudes:
MLv      2.64 +/- 0.26   7 preferred  BMKG
M        2.64            7            BMKG

10 Phase arrivals:
sta  net   dist azi  phase   time         res     wt  sta
BBJI  IA   0.62 357  P       16:53:53.571   0.7 M  1.0  BBJI
BBJI  IA   0.62 357  S       16:54:02.725   0.3 M  1.0  BBJI
CMJI  IA   0.82  69  P       16:53:55.628  -0.3 M  1.0  CMJI
CMJI  IA   0.82  69  S       16:54:06.942  -0.8 M  1.0  CMJI
CNJI  IA   0.94 325  P       16:53:57.377  -0.5 M  1.0  CNJI
CNJI  IA   0.94 325  S       16:54:09.925  -1.1 M  1.0  CNJI
KPJI  IA   1.45  59  P       16:54:05.708   0.7 M  1.0  KPJI
SKJI  IA   1.54 314  P       16:54:05.359  -1.1 M  1.0  SKJI
CBJI  IA   1.56 332  P       16:54:08.530   1.9 M  1.0  CBJI
CGJI  IA   2.45 306  P       16:54:19.254   0.2 M  1.0  CGJI

7 Station magnitudes:
sta  net   dist azi  type   value   res        amp per
BBJI  IA   0.62 357  MLv     2.57 -0.07   0.535197
CMJI  IA   0.82  69  MLv     2.53 -0.11   0.377317
CNJI  IA   0.94 325  MLv     2.24 -0.40   0.164214
KPJI  IA   1.45  59  MLv     2.32 -0.32   0.103117
SKJI  IA   1.54 314  MLv     3.06  0.42   0.497571
CBJI  IA   1.56 332  MLv     2.94  0.30   0.367885
CGJI  IA   2.45 306  MLv     2.85  0.20   0.0953526
```

Lampiran 2. Model Kecepatan Gelombang IASP91

Depth	Radius	Vp	Vs
0	6371	5.8	3.36
1	6370	5.8	3.36
2	6369	5.8	3.36
3	6368	5.8	3.36
4	6367	5.8	3.36
5	6366	5.8	3.36
6	6365	5.8	3.36
7	6364	5.8	3.36
8	6363	5.8	3.36
9	6362	5.8	3.36
10	6361	5.8	3.36
11	6360	5.8	3.36
12	6359	5.8	3.36
13	6358	5.8	3.36
14	6357	5.8	3.36
15	6356	5.8	3.36
16	6355	5.8	3.36
17	6354	5.8	3.36
18	6353	5.8	3.36
19	6352	5.8	3.36
20	6351	5.8	3.36
20	6351	6.5	3.75
21	6350	6.5	3.75
22	6349	6.5	3.75
23	6348	6.5	3.75
24	6347	6.5	3.75
25	6346	6.5	3.75
26	6345	6.5	3.75
27	6344	6.5	3.75
28	6343	6.5	3.75
29	6342	6.5	3.75
30	6341	6.5	3.75
31	6340	6.5	3.75
32	6339	6.5	3.75
33	6338	6.5	3.75
34	6337	6.5	3.75
35	6336	6.5	3.75
35	6336	8.04	4.47
40	6331	8.0406	4.4718
45	6326	8.0412	4.4735
50	6321	8.0418	4.4753
60	6311	8.0429	4.4788
70	6301	8.0441	4.4824
80	6291	8.0453	4.4859
90	6281	8.0465	4.4894
100	6271	8.0476	4.4929
110	6261	8.0488	4.4965
120	6251	8.05	4.5
120	6251	8.05	4.5
130	6241	8.0778	4.502
140	6231	8.1056	4.504
150	6221	8.1333	4.506
160	6211	8.1611	4.508
170	6201	8.1889	4.51
180	6191	8.2167	4.512
190	6181	8.2444	4.514
200	6171	8.2722	4.516
210	6161	8.3	4.518
210	6161	8.3	4.522
220	6151	8.3365	4.5394
230	6141	8.373	4.5568
240	6131	8.4095	4.5742
250	6121	8.446	4.5916
260	6111	8.4825	4.609
270	6101	8.519	4.6264
280	6091	8.5555	4.6438
290	6081	8.592	4.6612
300	6071	8.6285	4.6786
310	6061	8.665	4.696
320	6051	8.7015	4.7134
330	6041	8.738	4.7308
340	6031	8.7745	4.7482
350	6021	8.811	4.7656
360	6011	8.8475	4.783
370	6001	8.884	4.8004
380	5991	8.9205	4.8178
390	5981	8.957	4.8352
400	5971	8.9935	4.8526
410	5961	9.03	4.87

410	5961	9.36	5.07
420	5951	9.3936	5.0912
430	5941	9.4272	5.1124
440	5931	9.4608	5.1336
450	5921	9.4944	5.1548
460	5911	9.528	5.176
470	5901	9.5616	5.1972
480	5891	9.5952	5.2184
490	5881	9.6288	5.2396
500	5871	9.6624	5.2608
510	5861	9.696	5.282
520	5851	9.7296	5.3032
530	5841	9.7632	5.3244
540	5831	9.7968	5.3456
550	5821	9.8304	5.3668
560	5811	9.864	5.388
570	5801	9.8976	5.4092
580	5791	9.9312	5.4304
590	5781	9.9648	5.4516
600	5771	9.9984	5.4728
610	5761	10.032	5.494
620	5751	10.0656	5.5152
630	5741	10.0992	5.5364
640	5731	10.1328	5.5576
650	5721	10.1664	5.5788
660	5711	10.2	5.6
660	5711	10.79	5.95
670	5701	10.8166	5.9759
680	5691	10.8432	6.0019
690	5681	10.8697	6.0278
700	5671	10.8963	6.0538
710	5661	10.9229	6.0797
720	5651	10.9495	6.1057
730	5641	10.9761	6.1316
740	5631	11.0026	6.1576
750	5621	11.0292	6.1835
760	5611	11.0558	6.2095
760	5611	11.0558	6.2095
770	5601	11.0738	6.2172
780	5591	11.0917	6.2249
790	5581	11.1095	6.2326
800	5571	11.1272	6.2402
900	5471	11.2997	6.3138
1000	5371	11.464	6.3833
1100	5271	11.6208	6.4489
1200	5171	11.7707	6.511
1300	5071	11.9142	6.57
1400	4971	12.0521	6.626
1500	4871	12.1849	6.6796
2000	4371	12.7944	6.921
2500	3871	13.3697	7.1484
2700	3671	13.6076	7.2445
2740	3631	13.6564	7.2645
2740	3631	13.6564	7.2645
2750	3621	13.6587	7.267
2800	3571	13.6703	7.2794
2850	3521	13.6818	7.2918
2889	3482	13.6908	7.3015
2889	3482	8.0088	0
2900	3471	8.028	0
3000	3371	8.1995	0
3100	3271	8.3642	0
3200	3171	8.5222	0
3300	3071	8.6735	0
3400	2971	8.818	0
3500	2871	8.9558	0
4000	2371	9.5437	0
4500	1871	9.9633	0
5153.9	1217.1	10.2578	0
5153.9	1217.1	11.0914	3.4385
5500	871	11.1644	3.5
6000	371	11.227	3.5528
6371	0	11.2409	3.5645

Lampiran 3. Koordinat Stasiun Perekam Gempa

Nama Stasiun	Longitude	Latitude
BBJI	107.649856	-7.4625467
CMJI	108.448516	-7.783696
CNJI	107.13	-7.309
KPJI	108.931228	-7.333193
SKJI	106.5563	-7.0053
CBJI	106.934951	-6.698052
CGJI	105.6928	-6.6135
UGM	110.52192	-7.91248
DBJI	106.7497	-6.5538
XMIS	105.6519	-10.4807
LEM	107.6175	-6.8266
KASI	104.495964	-5.52361
SMRI	110.440768	-7.0490651
SWJI	111.7669	-7.7349
DSRI	104.5778	-0.4793
EGSI	102.27629	-5.35241
JCJI	108.2631	-6.7344
NGJI	111.4612	-7.3676
TNG	106.647	-6.172
MNAI	102.95571	-4.36048
PPSI	100.01	-2.766
LWLI	104.058914	-5.017472
KLI	104.870452	-4.836292
YOGI	110.295	-7.8166
JAGI	114.152046	-8.4703117
SBJI	106.1318	-6.1117
BLSI	105.24521	-5.367548
BWJI	112.6578	-5.8511
JMBI	103.576	-1.6764
SRBI	115.2126	-8.0848
MKBI	101.23958	-2.4474
PKKI	113.9721	-2.241
TPRI	104.32	0.92
UBSI	102.2714	-3.7611
ABJI	114.234	-7.7956
KSM	110.3083	1.4733
KOM	139.7628	35.65
MTKI	114.8959	-0.9418
PMSI	118.9149	-3.5008
GSI	97.5754	1.3036
MMSI	1.3036	-2.6892
PSI	98.924	2.6952
BKSI	120.122436	-5.321843
SPSI	121.648666	-0.910782
BASI	120.5777	-10.2189
TTSI	119.819	-3.0451
KUM	100.6492	5.2902
SNSI	96.3267	2.4089
MMRI	122.237605	-8.635715
EDFI	121.6903	-8.7497
BBSI	122.569458	-5.48845
TOLI2	120.794456	1.121398
KKM	132.718	-5.6923
MRSI	121.940589	0.477076
SOEI	124.267243	-9.755265
LUWI	122.771635	-1.0418067
LDM	-115.3172	48.4539
ALKI	124.5903	-8.1445
ATNI	124.8644	-9.0835
SMSI	122.3654	0.9885
MBWA	119.7312	-21.159
KMSI	123.980674	0.574544
SANI	125.9881	-2.0497
TMSI	124.92	1.2948
NLAI	127.0998	-3.239
FITZ	125.639	-18.102
TNTI	127.366901	0.772055
MORW	116.0388	-29.0683
GLMI	127.7879	1.8381
BNDI	129.54272	-4.31346
BSMI	130.4939	-3.1075
SAUI	131.2988	-7.9826
MTN	131.1327	-12.8436
RAPI	130.8211	-0.4102
SWI	131.2592	-0.8628
KMPI	133.7044	-3.66168
HALK	80.6806	6.08766
FORT	128.059	-30.779

DGAR	72.4525	-7.4121
BBOO	136.0583	-32.8096
PPBI	106.1364	-2.1616
PMBI	104.69925	-2.90243
PDSI	100.4617	-0.9118
PLAI	117.7219	-8.7006
DBNI	118.312133	-8.501888
SBM	-107.1807	33.9752
LRTI	123	-8.2752
AAII	128.194	-3.6871
AAK	74.494	42.639
STKI	111.4772	0.0656
TRSI	98.9594	2.0256
MEEK	118.6145	-26.6378
BLDU	116.7091	-30.6147
CHTO	98.9438	18.8138
NWAO	117.2339	-32.9269
KMBL	121.8821	-31.3669
MOO	147.1903	-42.4417
PATS	158.3125	6.8367
CNB	149.3633	-35.315
ARMA	151.6293	-35.315
SBV	49.9212	-13.4584
CASY	110.5364	-66.2792
NIL	73.2686	33.6506
RER	55.746	-21.159
ABPO	47.2275	-19.0174
UOSS	56.2042	24.9453
VOI	46.7059	-22.026
KIBK	38.0433	-2.35907
KMBO	37.2523	-1.1268
FURI	38.6783	8.8967
LODK	35.36165	3.42195
POGA	31.707	-27.346
VNDA	161.8528	-77.5172
LSZ	28.1882	-15.2766
EIL	34.9512	29.6699
NIUE	-169.9272	-19.0763
LBTB	25.597	-25.0145
BOSA	25.2555	-28.6141
CVNA	19.7617	-31.4821

CER	19.2933	-33.3617
SNAA	-2.8379	-71.6707
BKB	116.904826	-1.1073183
JOW	128.2725	26.836
LHI	159.0613	-31.52
MAW	62.8706	-67.6039
EIDS	151.0817	-25.3691
STKA	141.5952	-31.8769
WOJI	110.9236	-7.8372
WRAB	134.3502	-19.9333
COEN	143.1749	-13.9574
BATI	123.6633	-10.2065
SISI	102.5927	-2.3924
IGBI	115.146	-8.818
CMSA	145.6916	-31.5375
DNP	115.209701	-8.677404
GRJI	112.479354	-6.914433
GTOI	122.87	-6.914433
BYJI	114.3557	-8.214
BKNI	101.039638	0.3264167
GMJI	113.444145	-8.273206
CTAO	146.2544	-20.0883
ULN	107.0528	47.8652
BTDF	103.7729	1.3608
OBMI	127.6444	-1.3414
SIJI	131.26605	-0.86912
FAKI	132.26503	-2.9192317
PMG	147.1589	-9.4062
TOO	145.4906	-37.5714
RKPI	134.1773	-1.5107
KRAI	128.394729	-3.318356
LBMI	127.500816	-0.637887
TATO	121.4881	24.9754
SKLT	100.619	7.1735
DAV	125.579	7.07
JAY	140.70433	-2.5144
SUR	20.8117	-32.3797
KAPI	119.7517	-5.0142
RAYN	45.5032	23.5225
CTA	146.2544	-20.0883
IPM	101.0255	4.4795

SGSI	125.5286	3.6859
LHSI	103.52333	-3.826624
MASI	102.239608	-3.141521
PWJI	111.8039	-8.22
TWSI	116.8821	-8.7381
SDSI	101.428	-0.9325
COCO	96.8349	-12.1901
AAII	128.19429	-3.687109
KSI	102.59292	-3.651
SLSI	102.5927	-2.3924
UWJI	110.9474	-6.4191
MDSI	104.17823	-4.486037
BSSI	120.4904	-6.1428
PBKI	111.6697	-2.7047
YNG	148.3963	-34.298
LASI	97.970367	4.457251
HMDM	73.18216	6.77314
MPSI	119.898	0.3374
SKLT	100.619	7.1735
KLNI	116.094932	-8.421889
KCSI	97.771575	3.522185
KBL	69.0432	34.5408
TNGI	106.647	-6.172
KKSI	121.651252	-4.171717
BNSI	120.106521	-4.400521
SSJM	106.9626	-6.8872
JTJM	106.8015	-7.0573
CCJM	107.14019	-7.01692
WSJM	106.7247	-6.97472
CSJI	106.521	-7.3302
CIJM	108.1853	-6.4926
CBJM	107.35624	-6.93085
SCJM	107.2221	-6.8437
MBJI	109.6322	-7.4488
CIJI	108.19589	-7.31741
LLSM	104.80943	-5.60039
LHSM	103.5539	-4.1892
BPSM	100.58998	-1.1924
PSLI	105.51004	-5.93732
WLJI	105.890946	-6.8310983
PKJM	108.43985	-6.79577

MDSI	104.17823	-4.486037
BOSM	104.020736	-4.859183
LESM	103.71256	-4.96147
UTSI	104.55095	-5.31257
SEJM	108.5852	-6.8726
TSJM	107.8109	-6.7319
PPLI	105.14486	-5.74103
UWJI	110.9474	-6.4191
BYJI	114.3557	-8.214
KHK	115.60964	-8.36404
MBBI	102.0984	-1.5406
SOEI	124.267243	-9.755265
SLSM	100.65342	-0.83132
SUSM	104.2945	-5.0212
TOJI	108.1344	-6.7621
KWJI	109.9691	-7.3837
CWJM	107.44486	-6.74236
ACJM	108.6151	-6.8033
GKJM	110.5922	-7.8411
BOJI	110.68936	-7.56815
WOJI	110.9236	-7.8372
JWJM	110.731458	-7.206245
PSSM	104.69528	-5.86438
MTSM	103.5062	-4.4793
LHSI	103.52333	-3.826624
UTSM	102.72849	-4.08339
SEJI	111.7288	-7.0051
GEJI	112.64507	-8.41019
PPJI	112.635	-7.7054
BUJI	109.46133	-7.75603
TDNI	97.815	0.5792
SSKI	108.96	0.8178
SRSI	120.87	-2.5315
PBJI	107.4757	-7.0874
PKJI	109.5798	-7.1678
BKJI	108.5322	-7.3633
CSJM	108.0099	-6.74052
PRJI	110.79178	-8.07216
GBJI	109.966	-6.9485
PSJM	106.54906	-6.96858
MLJI	112.446699	-8.157473

BTJI	109.1641	-7.1972
BPJI	109.99712	-7.81045
JBJI	106.46986	-6.48374
JPJI	107.4175	-6.5307
MKSM	103.36025	-4.571007
MPSM	100.1383	0.5891
NKBI	115.525963	-8.726115
WRJI	113.74565	-7.81129
LUJI	113.0107	-7.826
PLJI	112.1548	-7.8616
TUJI	113.7322	-8.4018
TAMI	128.110803	-3.675906
PTJI	106.748825	-6.2655167
PCJM	108.71924	-6.91299
SBJM	110.266119	-7.967995
MBSM	101.8744	-3.13437
BAJI	112.70853	-7.09057
MLJM	112.3379	-7.2483
KLJI	113.25175	-7.99607
LLSI	102.9139	-3.27843
WGJM	112.5098	-7.3833
KBBI	115.2547	-8.286
JMSI	101.88745	-2.63715
BMSI	102.31544	-2.06641
BLSM	102.7617	-2.6232
JASI	101.45838	-1.41453
TMSM	101.44633	-2.69954
DBKI	114.9079	-1.6792
SMSM	100.17103	-0.005923
SASI	99.8754	0.12413
PABI	99.8719	0.1236
BBCM	121.436232	1.158027
LPCM	119.5378	-3.5012
LSCM	119.8987	-4.365
PBCI	124.0396	0.38301
TSPI	132.0898	-1.4733
SNBI	97.429538	0.963245
SWCM	120.0109	-4.2145
ULSM	102.7941	-3.7588
JHMI	127.47828	1.082067
BYLI	116.4201	-8.2273
KPJM	111.9281	-7.1883
TTSM	99.4108	1.0856
PMMI	127.4158	0.3738
TGCM	123.0778	0.5201

Lampiran 4. Koreksi Stasiun MJHD

Nama Stasiun	Longitude	Latitude
ABJI	114.2342	-7.7957
APSI	121.6487	-0.9108
BBKI	114.8411	-3.4625
BBSI	122.5704	-5.4875
BKB	116.8963	-1.2605
BKNI	101.0396	0.3262
BKSI	120.1224	-5.3219
BLJI	113.595	-7.745
BLSI	105.2452	-5.3676
BNDI	129.9045	-4.5224
BSI	95.296097	5.4964
BSSI	120.4904	-6.1428
BTDF	103.77289	1.36081
BWJI	112.6578	-5.8511
BYJI	114.3557	-8.214
CBJI	106.85	-6.42
CGJI	105.6929	-6.6135
CMJI	108.4485	-7.7837
CNJI	107.1296	-7.309
CTJI	109.1836	-7.0075
DAV	125.579	7.07
DBJI	106.7497	-6.5538
DBNI	118.3121	-8.5019
DLV	108.48667	11.94333
DNP	115.2102	-8.6772
DSRI	104.5778	-0.4793
EDFI	121.6903	-8.7497
EGSI	102.2767	-5.3526
FAKI	132.24889	-2.91925
GENI	140.1678	-2.5927
GMJI	113.4441	-8.2732
GRJI	112.4793	-6.9145

GSI	97.5755	1.30389
GTOI	123.0105	0.6358
HNR	159.94701	-9.43164
IGBI	115.1456	-8.8181
IPM	101.0255	4.4795
JAGI	114.1521	-8.4702
JAY	140.7047	-2.5148
JCJI	108.27	-6.49
JMBI	103.6417	-1.6335
KAPI	119.75169	-5.01419
KASI	104.4967	-5.5236
KDI	122.6192	-3.9574
KHK	115.608	-8.36433
KIBK	38.046001	-2.34
KKM	116.21469	6.04431
KKSI	121.6513	-4.1718
KLI	104.8567	-4.863
KLNI	116.0949	-8.4219
KLSI	104.73	-4.69
KMMI	113.9667	-7.05
KMPI	133.70441	-3.6616
KMSI	123.9807	0.5745
KNRA	128.7627	-15.67689
KPJI	108.931	-7.333
KRAI	128.3947	-3.3184
KRJI	101.4619	-2.0912
KRK	112.4525	-8.1583
KSI	102.5929	-3.6517
KSM	110.30833	1.47333
LBFI	119.89	-8.48
LBMI	127.5008	-0.6379
LEM	107.6175	-6.82661
LHMI	96.947197	5.2288
LHSI	103.5233	-3.8267
LUWI	122.7717	-1.0418
LWLI	104.0589	-5.0175
MASI	102.2396	-3.1415
MBWA	119.73119	-21.159
MDSI	104.1783	-4.4861
MEEK	118.6135	-26.6376
MGCD	151.10919	-33.20961

MKS	119.47	-5.21783
MMRI	122.2376	-8.6357
MMSI	118.91	-2.69
MNAI	102.9557	-4.3605
MNI	124.83989	1.44389
MNSI	99.579597	0.7955
MORW	116.0403	-29.0679
MPSI	119.898	0.3374
MRSI	121.9406	0.4771
MSAI	128.9285	-3.3461
MTKI	114.8959	-0.9418
MTN	131.13269	-12.84361
MTSU	144.3168	-18.13419
NGJI	111.4612	-7.3676
NIL	73.251701	33.650002
NLAI	127.0998	-3.239
NWAO	117.234	-32.926998
PALK	80.702187	7.27281
PBKI	111.6697	-2.7047
PBSI	98.279999	-0.0547
PCI	119.8366	-0.9054
PCJI	111.1771	-8.1947
PDSI	100.4617	-0.9118
PMBI	104.772	-2.927
PMG	147.159	-9.40617
PMSI	118.9149	-3.5008
PPBI	106.1364	-2.1616
PPI	100.397	-0.4568
PPSI	100.0096	-2.763
PSI	98.924004	2.801
PWJI	111.8039	-8.022
RKPI	134.17731	-1.5107
RTBI	114.942	-8.4597
SANI	125.9881	-2.0496
SAUI	131.29981	-7.9826
SBJI	106.13	-6.12
SBSI	98.889999	1.55
SCJI	109.1689	-7.681
SDSI	101.4282	-0.9324
SIJI	131.3	-0.9
SISI	99.0895	-1.3265

SKJI	106.5563	-7.0053
SKLT	100.62	7.17
SMKI	117.2085	-0.4461
SMRI	110.44067	-7.04915
SNSI	96.326698	2.4089
SOEI	124.2672	-9.7553
SPSI	119.7691	-3.9646
SRBI	115.2127	-8.0848
STKI	111.4772	0.0656
SWI	131.2598	-0.863
TBJI	111.8481	-6.8179
TNG	106.6462	-6.1717
TNTI	127.3667	0.7718
TOLI	120.7944	1.1214
TPI	107.65339	-2.75631
TPRI	104.5263	0.9184
TTSI	119.819	-3.0451
TWSI	116.8821	-8.7381
UBSI	102.2714	-3.7611
UGM	110.5231	-7.9125
UWJI	110.9474	-6.4191
WBSI	119.3911	-9.6411
WOJI	110.9236	-7.8372
WRAB	134.35001	-19.9333
WSI	120.2976	-9.6689
XMI	105.6895	-10.4495
XMIS	105.65189	-10.48072
YNG	148.39632	-34.298
YOGI	110.2949	-7.8166

Lampiran 5. Format MJHD (mjhd.data dan mjhd.out0)

```
   1  201712301653   40.0000   -8.0800  107.6800   20.0000    2.6400  10
     BBJI     53.50     0.7    0.62 357.0
     BBJI     62.70     0.3    0.62 357.0
     CMJI     55.60    -0.3    0.82  69.0
     CMJI     66.90    -0.8    0.82  69.0
     CNJI     57.30    -0.5    0.94 325.0
     CNJI     69.90    -1.1    0.94 325.0
     KPJI     65.70     0.7    1.45  59.0
     SKJI     65.30    -1.1    1.54 314.0
     CBJI     68.50     1.9    1.56 332.0
     CGJI     79.20     0.2    2.45 306.0
   2  20171229 749   24.0000   -8.0900  108.0600   71.0000    2.7500   6
     CMJI     38.70     0.3    0.49  51.0
     BBJI     40.20    -0.3    0.75 327.0
     KPJI     44.40    -0.2    1.15  49.0
     CNJI     45.50     0.2    1.21 310.0
     CBJI     46.10    -6.8    1.78 321.0
     UGM      61.80    -0.0    2.45  86.0
   3  20171229 146   16.0000   -7.6000  107.4200   67.0000    2.4800   6
     BBJI     29.00     0.2    0.27  59.0
     CNJI     30.60     0.5    0.41 315.0
     CMJI     35.60    -0.1    1.04 100.0
     SKJI     35.90     0.1    1.04 305.0
     DBJI     38.00    -0.3    1.23 327.0
     KPJI     42.10     0.1    1.52  80.0
   4  20171227 7 5    4.0000   -7.9900  105.0600   12.0000    3.8400  15
     CGJI     30.60    -0.1    1.51  25.0
     SKJI     34.40    -0.2    1.78  57.0
     CNJI     39.80    -0.1    2.16  72.0
     DBJI     40.20    -0.4    2.20  50.0
     KASI     45.10     0.2    2.52 347.0
     XMI      44.70    -0.2    2.52 166.0
```

```
   1 171230165340.00-0.00 107.6800 0.0000 -8.0800 0.0000 20.00 0.00 2.6 10 0.000
   2 171229 74924.00-0.00 108.0600 0.0000 -8.0900 0.0000 71.00 0.00 2.8  6 0.000
   3 171229 14616.00-0.00 107.4200 0.0000 -7.6000 0.0000 67.00 0.00 2.5  6 0.000
   4 171227 7 5 4.00-0.00 105.0600 0.0000 -7.9900 0.0000 12.00 0.00 3.8 15 0.000
   5 171226111348.00-0.00 106.7200 0.0000 -8.5200 0.0000 10.00 0.00 3.3  9 0.000
   6 171226 41130.00-0.00 107.9000 0.0000  8.1400 0.0000 17.00 0.00 2.7  5 0.000
   7 171226 02630.00-0.00 108.6000 0.0000 -8.5300 0.0000 59.00 0.00 3.3 11 0.000
   8 1712241542 7.00-0.00 106.4400 0.0000 -7.7600 0.0000 12.00 0.00 4.5 21 0.000
   9 171224134827.00-0.00 105.4090 0.0000 -6.1300 0.0000127.00 0.00 3.8 15 0.000
  10 171223214633.00-0.00 107.6500 0.0000 -8.1700 0.0000 17.00 0.00 3.2 12 0.000
  11 171223115246.00-0.00 107.7600 0.0000 -7.7700 0.0000113.00 0.00 2.7  7 0.000
  12 171221223013.00-0.00 105.3600 0.0000 -6.2100 0.0000 10.00 0.00 3.2  9 0.000
  13 17122117 244.00-0.00 105.2700 0.0000 -7.9400 0.0000 80.00 0.00 3.5 15 0.000
  14 171221164841.00-0.00 107.2500 0.0000 -7.9000 0.0000 28.00 0.00 3.8 15 0.000
  15 1712201514 6.00-0.00 107.3600 0.0000 -8.1100 0.0000 15.00 0.00 3.0 10 0.000
  16 1712191111 8.00-0.00 106.2100 0.0000 -6.7300 0.0000109.00 0.00 3.7 13 0.000
  17 171216145548.00-0.00 107.6000 0.0000 -7.5800 0.0000 99.00 0.00 2.7  8 0.000
  18 171216 52739.00-0.00 107.7300 0.0000 -9.9900 0.0000 10.00 0.00 3.7  8 0.000
  19 171216 45528.00-0.00 108.0400 0.0000 -8.1000 0.0000 61.00 0.00 4.0 14 0.000
  20 171216 35821.00-0.00 108.1100 0.0000 -8.1100 0.0000 69.00 0.00 2.8  6 0.000
  21 171216 259 3.00-0.00 106.9100 0.0000 -7.9700 0.0000 18.00 0.00 2.9  7 0.000
  22 171216 25622.00-0.00 106.5200 0.0000 -6.7900 0.0000 10.00 0.00 2.6  6 0.000
  23 171216 24428.00-0.00 108.1100 0.0000 -8.0700 0.0000 73.00 0.00 3.5 11 0.000
  24 171216 2 823.00-0.00 107.5100 0.0000 -6.6800 0.0000 10.00 0.00 2.8 11 0.000
  25 171216 04558.00-0.00 106.9600 0.0000 -7.9400 0.0000 13.00 0.00 2.8  8 0.000
  26 171216 036 9.00-0.00 106.8600 0.0000 -8.0100 0.0000 10.00 0.00 3.1 10 0.000
  27 1712152328 7.00-0.00 107.7200 0.0000 -8.1100 0.0000 37.00 0.00 2.5  5 0.000
  28 171215211820.00-0.00 106.8500 0.0000 -8.0200 0.0000 22.00 0.00 3.0 12 0.000
  29 1712152110 3.00-0.00 106.8300 0.0000 -8.0700 0.0000 30.00 0.00 4.5 21 0.000
  30 171215202433.00-0.00 106.5300 0.0000 -6.8800 0.0000 31.00 0.00 2.3  7 0.000
  31 171215191532.00-0.00 108.0500 0.0000 -8.1000 0.0000 70.00 0.00 2.6  7 0.000
  32 171215191336.00-0.00 108.0300 0.0000 -8.0800 0.0000 73.00 0.00 2.8 10 0.000
```

Lampiran 6. Parameter input MJHD

- *Station.inp*

```
mjhd.data
station.out
station.201101
6    8  :MEQ(min events),MNST(min stations)
```

- *Mjhd07.inp*

```
0    :iform, =1:first step, =0: after second step
mjhd.out3
mjhd.prn3
station.out
mjhd.out4
mjhd.prn4
107.0   -5.5  0.0 600.0 :x0(Longitude), y0(Latitude), ZFIX(1;2)
6  8    :MEQ(events number), MNST(stations)
10.0   4   999.00      :max-res, Iteration(ITRT=15), std1
0     :NAST(STATION TO BE EXCLUDED(14(A8,1X)))

0     :NEXC (EVENT TO BE EXCLUDED)

0.0  0.0  0.0     :slope
```

Lampiran 7. Hasil Relokasi MJHD

```
   4 171227 7 5 6.46 0.30 105.0744 0.0210 -7.8747 0.0185 74.7314.64 3.8 13 0.564
   5 171226111348.87 0.86 106.6218 0.0354 -8.6930 0.0953 43.7085.52 3.3  8 0.355
   7 171226 02630.18 0.77 108.6098 0.0264 -8.3382 0.0817114.04 9.28 3.3 10 0.637
   8 1712241542 9.48 1.16 106.4077 0.0130 -7.6952 0.0147 19.80 9.64 4.5 19 0.514
   9 171224134826.80 0.33 105.1496 0.0253 -5.9984 0.0331131.97 5.91 3.8 14 0.659
  10 171223214635.08 0.26 107.6767 0.0231 -8.0480 0.0273 36.0851.68 3.2 11 0.744
  12 171221223012.46 1.13 105.2342 0.1616 -6.2952 0.1912  9.7810.82 3.2  8 1.701
  14 171221164842.85 0.16 107.2929 0.0106 -7.7579 0.0135 72.19 4.43 3.8 13 0.345
  15 1712201514 8.75 0.66 107.3562 0.0346 -8.0290 0.0732 38.1748.28 3.0  9 0.615
  16 1712191111 8.25 1.09 106.2475 0.0389 -6.6469 0.0636127.9610.81 3.7 12 0.743
  19 171216 45525.39 3.47 108.2346 0.2070 -8.0027 0.1183114.2744.65 4.0 12 2.688
  23 171216 24428.11 0.34 108.1448 0.0155 -7.8742 0.0302110.14 5.69 3.5  9 0.453
  24 171216 2 823.23 0.46 107.5042 0.0236 -6.6641 0.0459 12.06 4.27 2.8  8 0.981
  26 171216 03611.08 0.93 106.8449 0.0264 -7.9307 0.0509 24.45 5.27 3.1  9 0.442
  28 171215211822.25 0.36 106.8473 0.0159 -7.9594 0.0139 30.93 3.74 3.0 11 0.443
  29 1712152110 5.61 0.44 106.8584 0.0134 -7.9483 0.0161 30.54 4.53 4.5 19 0.541
  32 171215191335.45 0.38 108.0615 0.0186 -7.8905 0.0234112.40 6.17 2.8  9 0.454
  33 171215185910.04 0.24 108.2557 0.0117 -7.6949 0.0186107.69 3.83 2.9 10 0.347
  34 171215183638.60 0.44 108.1605 0.0232 -7.9501 0.0269108.53 7.45 3.0 10 0.566
  35 171215182610.28 0.40 108.0995 0.0219 -7.9278 0.0247110.93 6.47 3.1 11 0.541
  36 171215173736.97 0.34 108.0531 0.0167 -7.9199 0.0200106.91 5.85 3.1 11 0.433
  37 171215171025.65 0.38 108.1064 0.0179 -7.8328 0.0305 97.59 6.93 3.4 10 0.563
  38 171215164757.91 0.20 108.0495 0.0154 -7.8271 0.0263118.93 2.72 7.0 93 1.270
  40 171212 7 241.12 0.20 106.2894 0.0134 -9.1138 0.0132 76.10 8.70 4.4 21 0.439
  41 171212 223 9.64 0.20 107.0222 0.0207 -7.1113 0.0329133.18 3.43 5.1 46 1.098
  42 171211 14539.06 1.00 105.2284 0.0748 -6.2547 0.0957  3.52 7.91 3.4  9 1.511
  43 171210171458.03 0.23 107.2772 0.0161 -8.1097 0.0156 52.2714.70 3.2 10 0.407
  44 171210111825.69 0.53 107.8672 0.0197 -8.1817 0.0209 24.83 6.18 3.7 12 0.572
  45 171210 95935.83 0.36 107.8727 0.0130 -8.1768 0.0156 26.17 4.02 4.0 11 0.416
  47 171210 14310.71 0.14 107.9233 0.0100 -8.0513 0.0177 42.3514.32 3.6 10 0.354
  49 1712 7213958.73 0.66 105.2990 0.0420 -6.1187 0.0473  6.47 6.16 3.2 13 1.359
  50 1712 7114030.17 0.47 108.3256 0.0180 -7.8386 0.0538 87.00 5.39 3.1 10 0.549
  51 1712 5193238.67 0.17 107.8733 0.0137 -8.0529 0.0214 41.4919.52 3.1 13 0.539
```

```
  52 1712 5 1 056.38 0.38 108.3279 0.0205 -8.1705 0.0352 90.59 8.46 3.6  9 0.613
  53 1712 3191414.77 0.62 106.4007 0.0283 -7.8642 0.0299 25.37 6.10 3.2  9 0.731
  54 1712 1165126.58 0.79 108.7433 0.0166 -8.4882 0.0336 29.64 7.99 4.2 23 0.901
  55 1712 1144350.11 0.62 105.8979 0.0204 -7.6076 0.0235  6.54 4.88 4.1 16 0.767
  56 171127224331.8499.99 107.4922 0.0136 -8.1072 0.0171 29.2699.99 3.9 12 0.494
  57 1711261943 4.42 0.87 105.3607 0.0697 -6.1771 0.0760  8.13 7.89 3.3 10 1.731
  58 17112619 654.87 1.36 105.2729 0.0502 -6.3257 0.0598  0.0010.17 3.3 60 2.753
  59 171126 81920.11 0.78 105.0733 0.0266 -6.7795 0.0341 14.06 5.77 4.1 13 0.773
  60 171126 5 353.60 0.09 106.6279 0.0084 -7.4738 0.0111 39.00 8.65 3.7 15 0.321
  61 171125 9 037.41 0.18 108.5015 0.0112 -8.4156 0.0223 68.04 7.40 3.9 14 0.456
  62 171121212237.31 0.40 106.6364 0.0253 -6.7603 0.0370  4.97 4.63 3.6  9 0.925
  64 171118 21047.56 0.41 106.9417 0.0360 -8.9705 0.0388 37.3036.20 4.0 12 1.104
  65 171117 4 221.28 0.21 107.3018 0.0209 -7.3962 0.0352127.40 3.28 5.0 53 1.202
  66 171115 2 524.38 1.44 106.1098 0.0201 -7.3605 0.0283 15.2912.44 3.5  9 0.653
  67 17111421 442.58 0.61 107.3123 0.0171 -8.1057 0.0227 24.07 6.58 3.6 11 0.592
  68 171113151133.12 1.05 106.5155 0.0520 -9.2554 0.0771169.1617.67 4.2 18 1.838
  69 171113 311 4.16 0.52 107.2252 0.0281 -8.0845 0.0251 92.4812.05 3.9  8 0.606
  70 1711121115 2.52 0.16 105.1081 0.0142 -6.3183 0.0141 77.98 4.40 3.6 10 0.340
  71 171112 71325.83 0.12 107.9067 0.0089 -8.0386 0.0161 41.8512.47 4.2 17 0.408
  73 1711 9165715.12 0.19 108.6307 0.0110 -7.4208 0.0280144.92 3.15 3.6 21 0.531
  75 1711 9143857.90 0.66 107.8608 0.0196 -8.2374 0.0256 21.31 7.09 3.5 12 0.681
  77 1711 8201445.71 0.43 107.9039 0.0210 -8.0467 0.0310100.36 9.13 2.9 11 0.659
  78 1711 7144213.94 0.20 107.8765 0.0169 -8.0190 0.0256 38.3837.65 3.3 11 0.583
  79 1711 618 910.32 0.41 107.8347 0.0137 -8.1581 0.0184 22.86 4.40 2.8  9 0.395
  80 1711 5174755.15 0.24 106.5774 0.0142 -9.0157 0.0152 90.39 8.60 4.2 19 0.485
  81 1711 5 94823.45 1.26 105.6342 0.0609 -5.8959 0.0922201.4216.31 3.8 13 1.504
  82 1711 31558 0.07 0.20 107.3241 0.0149 -8.0176 0.0173 42.4323.85 3.5 11 0.502
  85 1711 211 836.63 0.51 105.6045 0.0684 -6.1113 0.1165180.35 7.19 3.8 17 1.015
  88 1711 1 53936.80 0.17 107.3134 0.0129 -8.1221 0.0216 54.17 4.04 4.9 47 0.773
  91 171026 016 7.76 0.25 106.9162 0.0174 -8.9955 0.0275 89.84 9.52 4.6 28 0.861
  92 171025215917.78 0.17 108.3092 0.0110 -8.2718 0.0192 62.25 5.61 3.1  9 0.335
  94 171025202828.38 0.80 106.9712 0.0437 -8.9935 0.0481108.0123.09 4.0 15 1.400
  95 171025175129.89 0.36 106.8809 0.0197 -8.9748 0.0244103.4211.19 4.2 20 0.742
```

Lampiran 8. Parameter input *ph2dt*

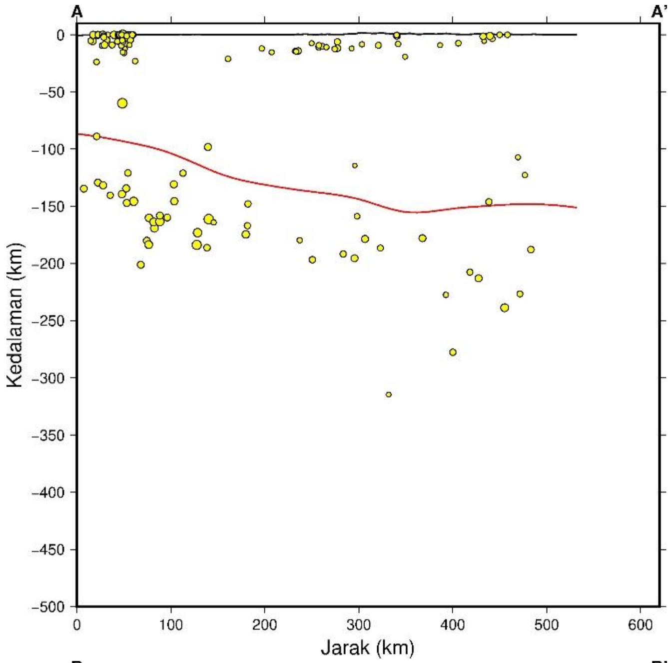
```
* ph2dt.inp - input control file for program ph2dt
* Input station file:
stasiun.dat
* Input phase file:
Jabar_Gabungan.pha
*MINWGHT: min. pick weight allowed [0]
*MAXDIST: max. distance in km between event pair and stations [500]
*MAXSEP: max. hypocentral separation in km [100]
*MAXNGH: max. number of neighbors per event [25]
*MINLNK: min. number of links required to define a neighbor [3]
*MINOBS: min. number of links per pair saved [3]
*MAXOBS: max. number of links per pair saved [50]
*MINWGHT MAXDIST MAXSEP MAXNGH MINLNK MINOBS MAXOBS
   0      500     100    25      3     3     50
```

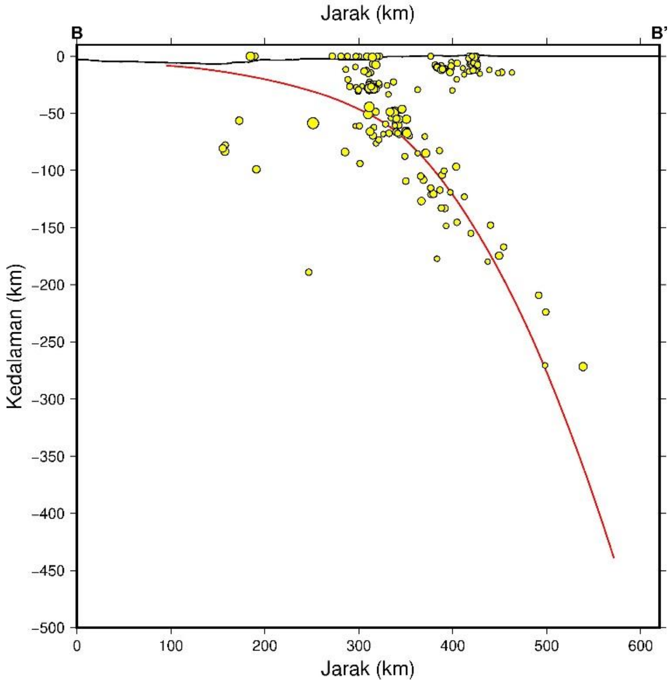
Lampiran 9. Parameter Input Inversi HypoDD

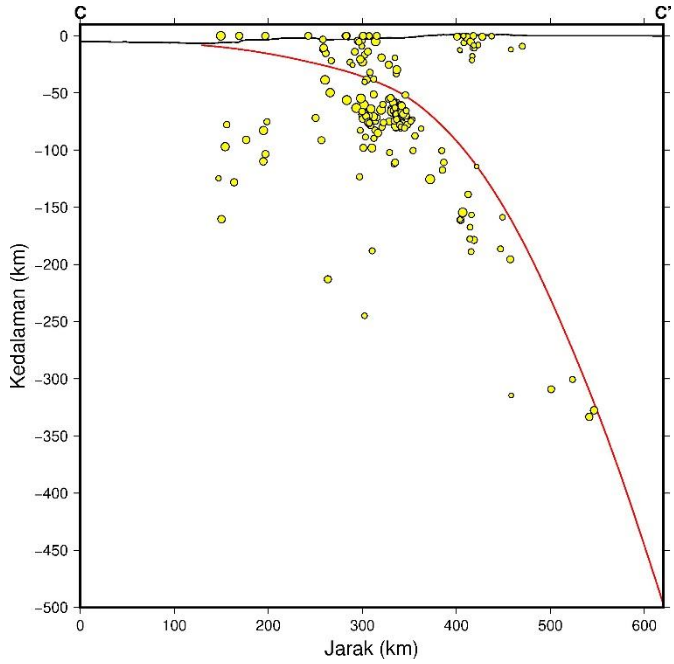
```
* RELOC.INP:
*--- input file selection
* cross correlation diff times:

*
*catalog P diff times:
dt.ct
*
* event file:
event.dat
*
* station file:
stasiun.dat
*
*--- output file selection
* original locations:
hypoDD.loc
* relocations:
hypoDD.reloc
* station information:
hypoDD.sta
* residual information:
hypoDD.res
* source paramater information:
*hypoDD.src
```

```
*--- data type selection: 
* IDAT:  0 = synthetics; 1= cross corr; 2= catalog; 3= cross & cat 
* IPHA: 1= P; 2= S; 3= P&S
* DIST:max dist [km] between cluster centroid and station 
* IDAT   IPHA   DIST
    2     3      500
*
*--- event clustering:
* OBSCC:    min # of obs/pair for crosstime data (0= no clustering)
* OBSCT:    min # of obs/pair for network data (0= no clustering)
* OBSCC  OBSCT    
     0     3       
*
*--- solution control:
* ISTART:  1 = from single source; 2 = from network sources
* ISOLV:  1 = SVD, 2=lsqr
* NSET:       number of sets of iteration with specifications following
*  ISTART  ISOLV  NSET
    2        2     3
*
*--- data weighting and re-weighting: 
* NITER:     last iteration to used the following weights
* WTCCP, WTCCS:  weight cross P, S 
* WTCTP, WTCTS:  weight catalog P, S 
* WRCC, WRCT:    residual threshold in sec for cross, catalog data 
* WDCC, WDCT:    max dist [km] between cross, catalog linked pairs
* DAMP:          damping (for lsqr only) 
*       ---  CROSS DATA ----- ----CATALOG DATA ----
* NITER WTCCP WTCCS WRCC WDCC WTCTP WTCTS WRCT WDCT DAMP
   5     -9     -9   -9   -9   0.01  0.05   2   100  100
   5     -9     -9   -9   -9   0.01  0.05   2   100  100
   5     -9     -9   -9   -9   0.01  0.05   2   100  100
*
*--- 1D model:
* NLAY:  number of model layers  
* RATIO:  vp/vs ratio 
* TOP:   depths of top of layer (km) 
* VEL:   layer velocities (km/s)
* NLAY  RATIO 
   9     1.73
* TOP
0.00  5.0 10.0 15.0 25.0 35.0 45.0 60.0 100.0 
* VEL
5.28  5.28 6.10  6.83  7.20  7.25  7.70 7.83 7.95 
*
*--- event selection:
* CID:  cluster to be relocated (0 = all)
* ID:  cuspids of event to be relocated (8 per line)
* CID    
    0     
* ID
```

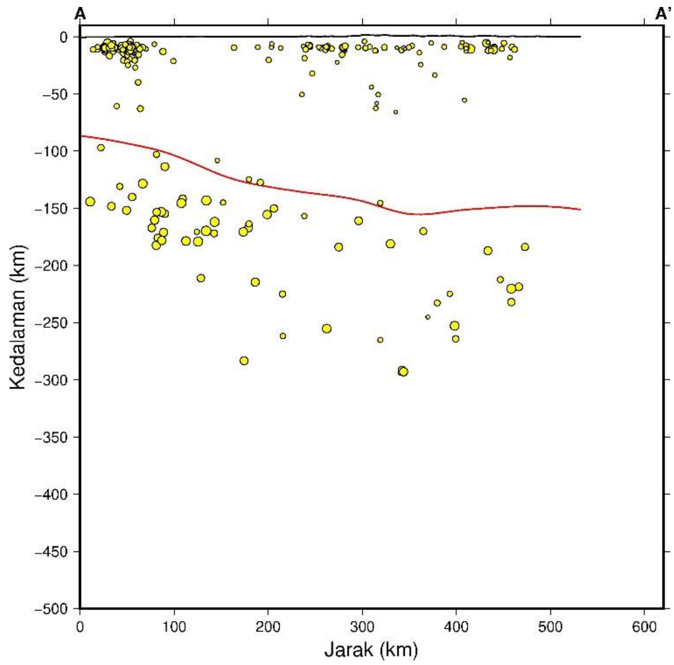
Lampiran 10. Hasil Penampang Relokasi *Modified Joint Hypocenter Determination*

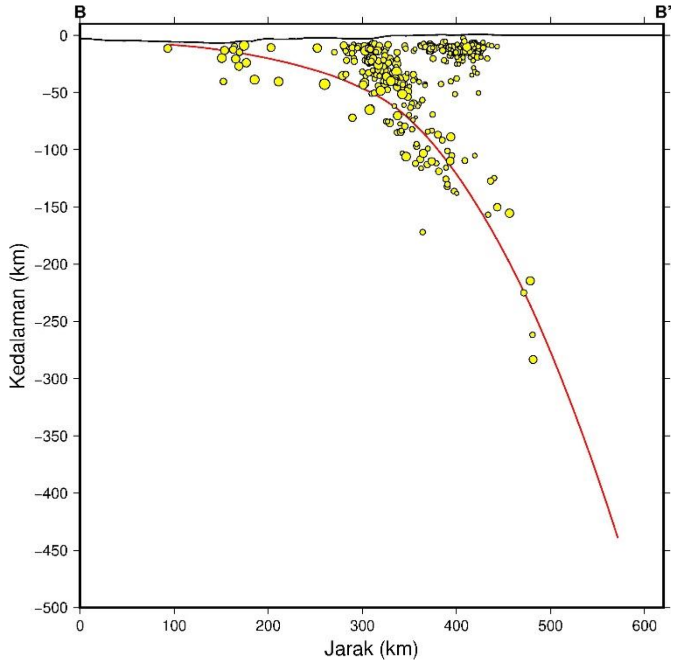


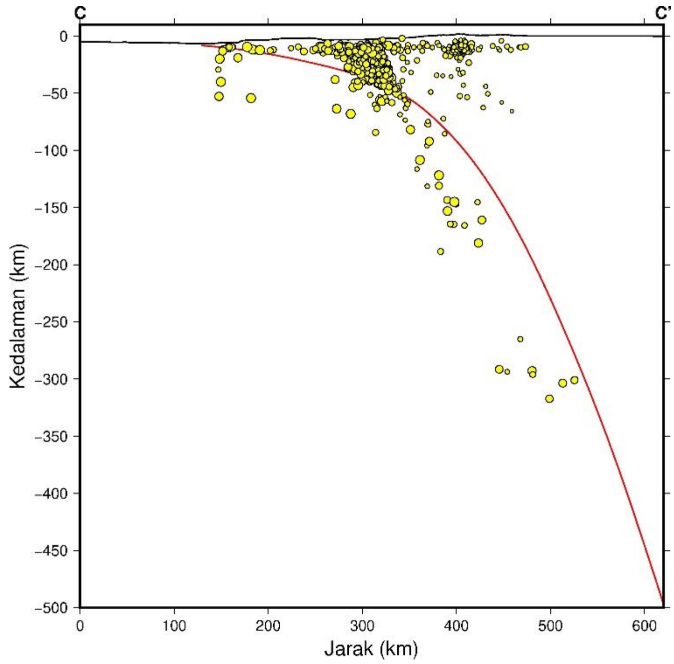




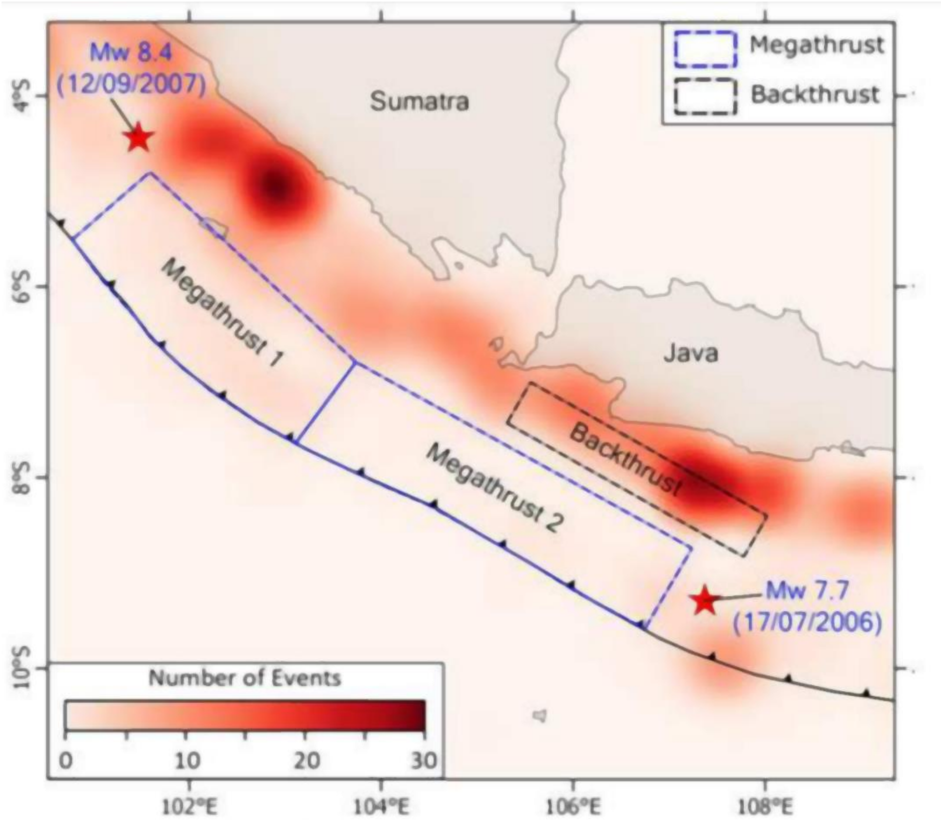
Lampiran 11. Hasil Penampang Relokasi *Double Difference*




B
B'
Kedalaman (km)
Jarak (km)
0
−50
−100
−150
−200
−250
−300
−350
−400
−450
−500
0
100
200
300
400
500
600


C
C'
Kedalaman (km)
Jarak (km)
0
−50
−100
−150
−200
−250
−300
−350
−400
−450
−500
0
100
200
300
400
500
600

Lampiran 12. Zona Megathrust dan Backthrust (Supendi dkk., 2022)

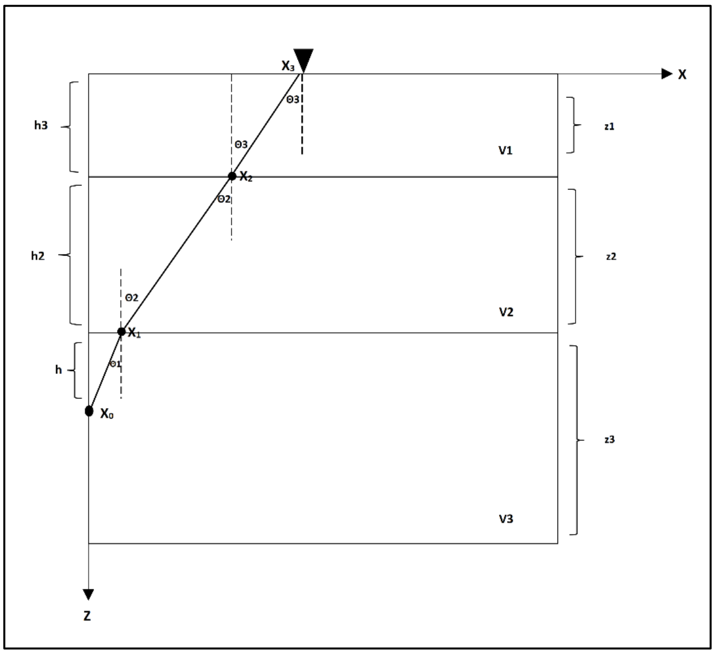


Lampiran 13. Script Distribusi Hiposenter dan *Cross-section*

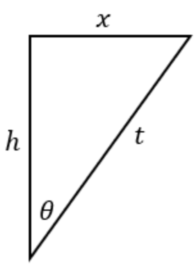
```
set input=relokasi_mjhd.txt
set data=sum_slab1.0_clip.grd
set output=final_mjhdA.ps
set clipfile=sum_slab1.0.clip
set cross=final_mjhdA1.ps
#Kedalaman Maksimum
set Dmax=450
#Interval kedalaman
set ID=60

#Membuat file warna
grd2cpt %data% -Cjet -Z> slab.cpt
makecpt -Cglobe -Z > elev.cpt
#%makecpt -Cno_green -I   -T0/350/50 -D > quake_depth.cpt
#%makecpt -Cred,yellow,blue -T0,60,300,600 -N > quake_depth.cpt
makecpt -Cseis -T0/%Dmax%/%ID% -D > quake_depth.cpt


#Menampilkan peta topografi dan batas pantai
#grdimage indo.nc -JM25.5 -Celev.cpt -K -R90/150/-15/15 -Y4> %output%
grdimage indo.nc -JM11 -Celev.cpt -K -R103/110.5/-11.2/-4.3 -Y4> %output%
pscoast -JM -R -B2f1WSNe -K -Dh -Wthin  -O >> %output%

#Menampilkan data slab dan melakukan "clip" agar hanya zona subduksi yang ditampilkan
#Serta membuat kontur dengan interval 20 km, perhatikan grdcontour bagian -C20
psclip %clipfile% -J -R -O -K >> %output%
grdimage %data% -Cslab.cpt -JM -R -K -O >> %output%
grdimage indo.nc -Celev.cpt -JM -R -K -O >> %output%
# grdcontour %data% -C20 -Ag -J -R -O -K -Wwhite >> %output%
psclip %clipfile% -J -R -O -K -C >> %output%
psxy %clipfile% -J -R -W1p -O -K >> %output%
pscoast -JM -R -B -K -O -Dh -Wthin  >> %output%
```

```
#Menampilkan batas subduksi
psxy -R -JM -W1.5,red -O -K trench.gmt>> %output%
psxy -R -JM -Wthin -m -O -K -W0.5,red, Java_fault.gmt >> %output%
psxy -R -JM -Wthin -m -O -K -W0.5,red, Sumatra_fault.gmt >> %output%
# psxy volcano.dat -R -J -St0.2 -Gred -W0 -O -K >> %output%


gawk "{print $1, $2, $3}" stasiun_BMKG.dat | psxy -J -R -Si0.2 -W0.5 -Gblue -O -H -P -K >> %output%
gawk "{print $4, $3, $5, $6*0.016}" %input% | psxy -J -R -Sci -W0.2  -Gred -P -O -H -K -Cquake_depth.cpt>> %output%

pscoast -JM -R -O -K -Dh -Wthinnest -P -Lf104.2/-9.4/12/200+l+jr --FONT_LABEL=10p >> %output%

#Menampilkan garis di wilayah yang akan dilakukan cross section
echo 105 -5.8 A> slice
echo 109.5 -7.5 B>> slice
psxy slice -J -R -O -K -W2 >> %output%


echo 105 -5.8 10 0 1 RT A> lineA.dat
echo 109.5 -7.5 10 0 1 LT A'>> lineA.dat
psxy lineA.dat -JM -R -W1 -P -O -K >> %output%
pstext lineA.dat -JM -R -P -O -K >> %output%

#Menampilkan skala warna
psscale -D5.5/-1/10/0.4h -Cquake_depth.cpt -B%ID%:"Kedalaman (km)": -O >> %output%

#Menampilkan hasil cross section
psbasemap -JX6.5i/6.5i -R0/620/-500/10 -Ba100:"Jarak (km)":/:"Kedalaman (km)":50WSne --FONT_LABEL=16p -K  > %cross%

#Garis hitam adalah hasil cross section peta topografi dan bathimetrinya
project -C105/-5.8 -E109.5/-7.5 -Q -G1 > track
grdtrack track -Gindo.nc  > tracked
gawk "{print $3, $4/1000}" tracked | psxy -JX -R -Wthick -O -K -B100::/100::WSne >> %cross%

#Garis merah adalah hasil cross section slab subduksi
project -C105/-5.8 -E109.5/-7.5 -Q -G1 > track2
grdtrack track2 -Gsum_slab1.0_clip.grd  > tracked2
gawk "{print $3, $4}" tracked2 | psxy -JX -R -Wthick,red -O -K -B100::/100::WSne >> %cross%

#menampilkan Seismisitas
gawk "{print $4, $3, $5*-1, $6*0.02}" %input% | project -Q -C105/-5.8 -E109.5/-7.5 -Fpz -W-30/30 > maincross.dat
psxy maincross.dat -JX -R -Sci -W0.5 -Gyellow -O -K -P>> %cross%

echo 0 15 14 0 1 BC A> teks.dat
echo 620 15 14 0 1 BC A'>> teks.dat
pstext teks.dat -JX -R -P -O -N >> %cross%

ps2raster -A -P -Tj %output%
ps2raster -A -P -Tj %cross%
```

Lampiran 14. *Travel time* 3 lapisan



Diumpamakan lapisan 3 merupakan titik hiposenter gempa (x_0) dengan kedalaman *h* yang berada pada batas lapisan 3 dan 2.



$t = \sqrt{x^2 + h^2}$ **(1)**

t merupakan nilai waktu tempuh kalkulasi yang akan dihitung pada setiap lapisan, h merupakan kedalaman pada lapisan ke titik gempa, dan *x* merupakan hiposenter pada batas lapisan. Maka, t_{cal} dari tiga lapisan yaitu:

$t_{cal\ total} = t_1 + t_2 + t_3$ **(2)**

Persamaan waktu tempuh kalkulasi dengan mengetahui parameter hiposenter (*x*,*y*,*z*), sebagai berikut:

$$t_{cal} = \sqrt{\frac{((x_1-x_0)^2+(y_1-y_0)^2+(z_1-z_0)^2)}{v}} \quad \textbf{(3)}$$

Dalam perhitungan *travel time* dengan menggunakan *ray parameter (p)* dapat menggunakan pula persamaan (4), dengan $p = \frac{sin\ \theta}{v}$, $dan\ u = \frac{1}{v}$.

$$t(p) = \sum_i^n \frac{u_i^2 \Delta z_i}{(u_i^2 - p^2)^{1/2}} \quad \textbf{(4)}$$