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LAMPIRAN

Lampiran 1. Data gempa bumi dari katalog BMKG dan USGS

long	lat	year	month	day	mag	depth	JM	MNT
120.25	1.54	2017	9	15	8.6	30	8	18
120.19	1.41	2017	9	15	8.5	15	8	11
119.931	0.729	1996	1	1	7.9	24	8	5
122.857	1.186	1990	4	18	7.8	25.7	13	39
120.537	-0.05	1938	5	19	7.7	35	17	8
121.5	1.8	2017	9	22	7.7	10	9	10
123.573	-1.11	2000	5	4	7.6	26	4	21
122.787	1.196	1991	6	20	7.5	31.4	5	18
122.835	0.731	1941	11	8	7.4	35	23	37
122.1	-0.19	2012	10	2	7.4	10	6	19
119.802	0.157	1968	8	14	7.2	20	22	14
123.68	-3.07	2016	6	24	7.2	10	1	36
119.85	-0.22	2018	9	28	7.1	10	10	2
118.904	-3.2	1969	2	23	7.0	15	0	36
118.806	-2.82	1984	1	8	7.0	33	15	24
122.957	1.156	1991	5	19	7.0	33	0	58
120.45	1	1996	7	22	7.0	33	14	19
122.536	1.241	1997	11	25	7.0	24	12	14
122.6	-1.88	2019	4	12	6.8	23.3	11	40
120.094	-1.92	1968	6	7	6.7	35	11	57
119.727	-1.96	1985	3	2	6.7	43.5	15	47
122.631	0.972	1991	8	8	6.7	12.4	2	9
119.584	0.207	1998	5	21	6.7	33	5	34
123.48	-2.97	2020	4	13	6.7	10	2	58
122.552	-0.61	1964	6	30	6.6	20	13	46
119.364	0.288	1970	3	27	6.6	25	18	36
120.119	0.041	1959	10	15	6.6	35	6	15
120.833	1.093	1983	10	27	6.6	27.7	19	43
120.254	1.016	1996	7	16	6.6	33	10	7
120.44	-1.29	2017	5	29	6.6	11.1	2	35
124.07	-1.02	2011	6	5	6.6	5	7	29
121.254	-3.07	1924	2	13	6.6	35	22	50
121.004	-1.4	1923	12	5	6.6	35	22	35
122.269	1.029	1943	9	5	6.6	35	8	34
122.191	-0.71	1966	4	23	6.6	20	0	9

121.091	-3.14	1924	7	29	6.5	35	5	18
121.052	1.084	1983	10	16	6.5	40.1	5	32
120.858	1.131	1983	10	25	6.5	33	0	36
123.018	1.315	1990	4	18	6.5	19.1	18	32
123.429	1.108	1990	4	19	6.5	23.7	12	40
122.01	-0.71	2021	7	26	6.5	12.9	12	9
119.04	0.44	2011	7	10	6.5	10	5	7
120.268	-1.45	1925	12	29	6.5	25	16	4
123.161	-0.63	1923	2	23	6.4	35	5	51
122.806	1.251	1936	10	3	6.4	25	21	50
123.892	-0.06	1945	10	16	6.4	55	16	3
123.114	-0.93	1959	12	2	6.4	25	9	34
123.412	-0.49	1955	10	21	6.4	35	23	9
119.67	-2.08	1985	3	1	6.4	17.1	17	11
121.528	0.494	1993	9	29	6.4	96.6	11	16
121.32	-0.14	2010	7	18	6.4	10	2	58
123.9	0.56	2019	5	31	6.4	10	3	39
119.933	-1.2	2005	1	23	6.3	11	20	10
123.195	-0.39	2006	6	24	6.3	26	21	15
124.09	-0.25	2014	11	15	6.3	96.9	3	8
121.79	-1.37	2020	7	16	6.3	10	12	26
121.821	0.624	1948	7	18	6.3	35	6	43
120.631	0.845	1946	2	28	6.2	35	2	22
119.535	-1.27	1941	6	23	6.2	35	9	28
123	-1.4	1927	8	4	6.2	25	15	47
120.751	-0.88	1927	12	1	6.2	20	4	37
121.632	-0.64	1964	10	11	6.2	25	21	15
120.462	-2.08	1968	6	7	6.2	38	21	30
122.826	1.192	1985	3	5	6.2	33	13	40
124.034	1.116	1990	12	13	6.2	33	12	26
119.541	0.2	1999	2	23	6.2	33	7	27
122.456	-1.72	1999	8	12	6.2	33	5	44
121.333	-1.2	2002	8	15	6.2	10	5	30
120.13	-1.26	2012	8	18	6.2	10	9	41
121.385	1.429	1946	1	7	6.2	35	6	14
119.57	-3.43	2010	7	24	6.2	18.1	7	36
124.05	-0.36	2015	2	15	6.2	10	2	55
120.039	-0.46	1965	4	6	6.2	25	9	42
120.419	1.235	1941	2	8	6.1	25	18	46

121.631	-0.72	1969	2	4	6.1	45	1	38
120.402	1.03	1979	3	8	6.1	28	14	49
120.332	0.475	1946	2	24	6.1	35	9	29
122.586	1.186	1992	4	16	6.1	30	8	0
120.187	1.019	1996	2	7	6.1	13.8	7	57
123.644	-1.36	1998	12	26	6.1	33	15	39
121.59	-2.47	2011	2	15	6.1	15.2	1	33
123.91	-0.77	2012	12	17	6.1	44.9	9	16
122.621	0.769	1975	5	27	6.1	70	10	18
120.97	1.65	2008	11	1	6.1	10	12	59
121.37	0.84	2012	6	2	6.1	10	10	14
119.48	-1.62	2012	7	10	6.1	10	10	29
119.74	1.24	2020	11	17	6.1	10	4	18
122.235	-0.57	1966	4	23	6.1	35	8	56
119.836	-1.89	1965	3	19	6.1	40	16	20
123.009	1.333	1991	5	19	6.0	33.4	1	19
121.035	-3.15	1941	12	9	6.0	15	2	43
119.69	-2.75	1971	5	7	6.0	26.8	0	21
121.893	-0.8	1927	2	21	6.0	35	12	25
120.402	-1.94	1954	9	20	6.0	50	0	39
119.785	-2.07	1985	2	24	6.0	61.1	2	26
123.021	1.3	1990	4	19	6.0	33	1	5
122.825	1.059	1990	4	26	6.0	24.4	15	40
123.869	1.158	1990	5	15	6.0	29.7	18	31
122.105	1.235	1991	11	1	6.0	37.1	2	51
124.04	1.068	1992	6	6	6.0	17.5	21	40
124.089	1.084	1992	6	10	6.0	30.5	2	13
121.678	1.29	1995	11	8	6.0	19.8	16	1
120.196	1.006	1996	7	28	6.0	33	10	40
119.84	-0.4	1998	10	10	6.0	33	16	32
123.286	-0.34	2006	7	23	6.0	28	8	22
122.38	-0.55	2015	3	15	6.0	30.1	11	17
119.83	-0.35	2018	9	28	6.0	15.6	7	0
119.76	0.02	2023	9	9	6.0	10	2	43
120.53	-0.32	2013	8	28	6.0	10	6	14
120.03	-0.51	2017	5	1	6.0	10	3	19
122.491	1.508	1943	9	12	6.0	35	1	31
122.111	-2.8	1961	8	11	6.0	20	22	37
123.931	-0.12	1973	1	27	6.0	55	13	8

124.213	-0.07	1967	2	19	5.9	95	23	28
123.947	-0.08	1967	2	25	5.9	75	11	20
119.756	-2.75	1972	4	16	5.9	15	22	35
119.665	-0.33	1948	3	26	5.9	35	13	23
120.141	0.586	1966	1	11	5.9	35	3	10
123.969	-0.11	1967	2	25	5.9	80	11	38
119.56	-2.2	1985	3	1	5.9	33	22	22
120.505	-1.02	1995	5	19	5.9	25.9	21	30
119.859	-0.38	1998	10	10	5.9	33	16	29
119.901	0.495	2002	6	16	5.9	34.8	0	0
122.35	0.599	2003	12	28	5.9	74.9	5	36
119.963	-1.17	2005	7	9	5.9	32.2	23	59
120.681	0.109	2008	10	20	5.9	96	4	54
120.44	0.13	2011	12	2	5.9	81.9	5	19
120.16	-1.72	2020	3	28	5.9	10.7	3	43
121.96	-0.69	2021	7	26	5.9	22.5	3	52
121.814	-0.49	1930	2	24	5.9	35	20	50
121.642	-0.02	1960	4	30	5.9	35	4	1
119.33	-1.16	2018	5	16	5.9	10	3	30
119.17	-3.02	2019	6	24	5.9	10	11	2
120.49	-1.23	2021	1	6	5.9	10	5	38
123.677	0.505	1936	6	5	5.9	35	14	37
122.347	0.839	1937	7	10	5.9	35	20	43
120.52	-1.73	1977	5	28	5.8	54	5	51
124.084	-0.08	1978	2	7	5.8	81	7	1
122.967	0.077	1979	4	22	5.8	79	18	16
119.573	-2.81	1979	9	29	5.8	21	12	41
123.291	-0.62	1982	5	7	5.8	91.9	5	36
122.1	-2.71	1961	8	7	5.8	15	4	22
120.366	-1.35	1980	8	16	5.8	33	13	30
119.691	-3.08	1963	6	5	5.8	35	22	54
121.476	1.162	1989	7	8	5.8	41.3	10	33
123.371	1.342	1990	5	26	5.8	33.8	2	57
123.97	1.03	1990	11	30	5.8	28.3	13	19
124.115	1.077	1992	6	11	5.8	27.6	2	3
120.098	1.028	1996	9	10	5.8	33	2	34
124.313	-0.03	1999	3	18	5.8	88.5	1	59
122.702	-0.28	1999	10	1	5.8	64.4	22	24
122.653	1.228	2008	2	7	5.8	35.6	7	50

121.95	-2.62	2012	4	16	5.8	22.3	2	17
122.28	-0.31	1972	5	10	5.8	15	22	3
122.92	-2.46	2010	4	16	5.8	10	4	47
119.03	-1.96	2013	7	14	5.8	10	7	14
120.18	-0.11	2014	9	17	5.8	10	1	30
122.43	0.45	2018	12	30	5.8	10	4	41
119.51	-3.35	2019	10	17	5.8	10	4	2
121.4	-1.2	2019	11	15	5.8	10	6	27
122.5	1.03	2021	8	10	5.8	10	2	3
119.794	-0.75	1932	7	30	5.8	35	12	13
122.88	1.055	1934	4	26	5.8	35	13	39
118.932	0.983	1964	11	16	5.7	35	22	40
119.556	-2.12	1985	3	1	5.7	33	22	21
122.663	1.294	1991	8	8	5.7	45.2	4	0
120.033	-0.15	1967	1	11	5.7	35	5	54
122.74	0.009	1974	2	13	5.7	11	23	37
121.564	-0.16	1983	7	22	5.7	66.1	4	27
122.18	0.73	2013	10	12	5.7	85.3	2	30
119.83	0.04	2018	9	28	5.7	13.6	10	14
120.01	-0.8	2018	9	28	5.7	10	10	16
120.831	0.551	1972	2	16	5.7	69.5	8	59
122.143	0.901	1984	10	26	5.7	60.3	6	38
123.006	1.126	1990	9	9	5.7	33.7	22	29
124.172	1.119	1992	6	9	5.7	42.1	14	45
119.679	-1.51	1993	1	3	5.7	37.2	4	23
124.208	-0.62	1993	5	30	5.7	74.9	22	34
120.115	0.986	1996	2	6	5.7	33	17	58
122.564	1.37	1996	5	19	5.7	32.1	23	21
120.453	0.36	1996	9	5	5.7	33	15	36
123.164	-3.55	1998	10	27	5.7	33	1	38
121.487	-0.94	1999	11	25	5.7	33	4	0
123.359	-1.22	2000	5	5	5.7	33	5	24
122.32	0.68	2002	3	17	5.7	79.4	3	37
122.25	1.37	2012	11	6	5.7	51.2	1	36
122.04	1.4	2021	2	22	5.7	46.5	7	22
122.779	-0.21	1934	9	11	5.7	35	8	13
119.263	0.637	1964	10	17	5.7	35	3	17
122.96	1.65	2010	4	17	5.7	72.2	11	36
122.41	-0.79	2010	5	8	5.7	10	5	39

123.54	1.34	2011	7	4	5.7	95.9	5	12
119.42	-1.96	2013	11	29	5.7	10	6	43
122.39	-2.92	2014	12	3	5.7	10	12	27
123.42	-2.02	2017	8	5	5.7	10	2	9
123.81	-1.75	2020	3	26	5.7	10	3	37
122.499	1.132	1939	3	25	5.7	25	5	39
119.823	-0.07	1959	7	14	5.7	25	22	31
124.145	-0.14	1968	2	6	5.6	100	4	37
119.476	-2.84	1973	4	27	5.6	33	18	17
121.945	-1.15	1929	11	14	5.6	35	20	43
122.582	-3.04	1973	11	28	5.6	33	19	49
124.094	-0.14	1977	12	13	5.6	56	14	27
120.297	1.154	1978	9	26	5.6	33	6	7
122.984	1.263	1990	4	18	5.6	35.3	17	6
119.99	-0.98	2018	9	28	5.6	13.9	10	25
119.96	-0.77	2018	9	28	5.6	18.2	10	50
119.595	-2.09	1985	3	1	5.6	33	12	52
122.765	1.166	1985	3	25	5.6	36.4	18	58
121.336	0.645	1986	12	22	5.6	96.1	2	4
122.189	-0.35	1988	10	28	5.6	15.3	10	37
120.061	1.012	1989	4	16	5.6	27.1	6	50
123.422	1.253	1990	6	9	5.6	34.3	21	38
121.5	1.056	1990	7	6	5.6	30.3	13	39
123.19	1.331	1992	7	15	5.6	44.1	6	34
122.702	0.73	1993	12	7	5.6	77.9	16	27
124.261	-0.59	1995	4	13	5.6	32.2	4	16
119.58	0.46	1996	1	11	5.6	37.7	19	45
120.406	1.023	1996	10	4	5.6	33	8	3
122.492	-1.78	1999	8	13	5.6	33	10	12
120.151	1.091	2000	4	8	5.6	33	15	28
122.551	-2.54	2000	5	7	5.6	31.3	17	21
123.354	-1.42	2000	5	14	5.6	33	10	47
123.305	-1.58	2000	10	11	5.6	33	4	34
122.752	1.295	2002	7	19	5.6	33	2	38
121.799	1.281	2006	6	16	5.6	25.7	2	56
122.631	1.274	2007	3	31	5.6	27.6	19	37
123.015	-0.14	2008	10	26	5.6	81	9	8
119.89	-1.06	2009	3	2	5.6	22.8	12	3
122.98	-0.12	2011	5	6	5.6	90.9	6	46

121.89	-0.73	2011	12	1	5.6	11.1	10	53
122.43	-2.93	2014	12	3	5.6	16.7	12	27
122.19	-2.78	2017	5	24	5.6	11.7	9	10
120.56	-1.81	2019	3	24	5.6	40.5	1	32
122.47	-1.9	2019	4	25	5.6	26.8	9	57
121.57	-0.88	2021	8	26	5.6	10	2	14
119.99	0.777	1969	4	27	5.6	35	1	37
120.03	-2.8	2012	12	5	5.6	10	4	20
123.89	1.15	2012	12	7	5.6	10	11	10
121.86	-2.31	2018	12	29	5.6	5	3	53
119.04	-2.21	2020	1	28	5.6	10	3	56
119.78	-1.88	2020	7	29	5.6	67	12	30
123.1	-0.44	2020	12	27	5.6	10	3	7
119.18	-0.88	2021	3	22	5.6	10	10	53
123.18	-1.6	2021	3	31	5.6	10	7	35
120.94	0.26	2021	4	15	5.6	10	3	58
122.76	0.55	2021	5	18	5.6	10	5	40
122.975	0.604	1937	3	21	5.6	25	18	8
121.127	1.428	1971	2	12	5.6	35	23	33
120.045	0.966	1971	2	22	5.6	25	8	27
123.427	0.891	1929	2	28	5.6	35	0	13
118.877	-3.27	1969	1	15	5.5	35	12	59
124.17	-0.02	1970	3	7	5.5	94.9	22	30
122.8	-0.12	1966	7	13	5.5	92.3	14	40
121.81	-0.61	1970	9	14	5.5	18.8	0	53
119.809	-2.81	1971	8	5	5.5	53.3	4	50
121.647	-0.71	1972	10	12	5.5	20	16	45
119.952	-0.24	1968	8	15	5.5	35	11	40
123.288	-0.64	1985	3	10	5.5	71.1	5	1
123.254	1.234	1990	4	21	5.5	32.9	5	14
122.776	1.081	1990	6	2	5.5	33.8	4	57
123.188	1.298	1990	12	17	5.5	33	1	43
120.368	0.841	1993	8	8	5.5	34.1	0	31
119.912	0.692	1996	1	1	5.5	33	22	41
119.896	0.633	1996	1	3	5.5	33	11	23
120.407	1.112	1996	4	3	5.5	32.6	17	26
124.073	-0.15	1997	4	21	5.5	50	2	42
121.847	-0.72	1997	8	14	5.5	33	21	47
124.066	-0.9	1997	10	18	5.5	35.6	2	40

119.484	0.232	1999	2	25	5.5	33	18	18
122.909	-0.16	1999	4	8	5.5	91.8	11	30
121.441	-0.42	1999	5	13	5.5	34.7	13	54
123.134	-1.4	2000	8	20	5.5	33	22	38
121.554	-0.85	2000	12	10	5.5	33	10	5
120.495	1.158	2003	5	26	5.5	33	15	50
123.646	-0.45	2003	7	21	5.5	33	19	45
122.945	-0.16	2003	9	12	5.5	94.3	9	3
123.36	-0.67	2004	6	29	5.5	10	11	40
124.189	-0.44	2007	2	13	5.5	84.8	19	22
123.72	-0.62	2017	12	6	5.5	41.3	4	6
120.59	0.33	2017	3	31	5.5	98.2	11	21
119.17	-2.2	2020	10	27	5.5	28.2	7	43
121.714	-0	1975	9	10	5.5	33	4	17
123.126	1.21	1990	7	2	5.5	33.5	10	3
120.307	1.356	1927	11	20	5.5	15	17	14
122.058	-2.7	1980	11	5	5.5	46	18	15
120.867	0.44	1981	10	11	5.5	94.3	0	36
120.679	0.196	1982	9	24	5.5	82	19	47
123.131	0.368	1990	4	18	5.5	33	13	54
122.645	1.129	1990	4	18	5.5	33	14	35
122.882	1.173	1991	6	20	5.5	20.7	6	27
119.838	0.523	1996	1	1	5.5	33	9	14
120.459	1.036	1996	7	22	5.5	33	14	31
119.78	0.16	2013	4	30	5.5	54.3	10	33
119.67	0.02	2018	9	28	5.5	12.5	1	35
119.48	-1.17	2011	12	19	5.5	10	1	23
121.51	-2.95	2012	6	14	5.5	5	6	16
121.63	-1.78	2014	10	8	5.5	10	5	29
119.34	1.02	2014	12	29	5.5	10	11	44
123.34	-1.85	2015	3	17	5.5	10	8	13
119.92	0.44	2016	6	29	5.5	10	5	18
122.07	-2.43	2019	9	29	5.5	76.1	2	16
123.92	-3.36	2019	11	15	5.5	10	1	52
120.1	-0.66	2021	5	21	5.5	10	4	33
123.027	1.315	1991	5	19	5.4	35	3	40
123.485	1.255	1992	9	23	5.4	28.8	8	16
119.572	0.938	1997	10	30	5.4	33	16	27
119.929	0.82	1984	5	15	5.4	46.3	15	23

123.29	-3.44	1984	7	9	5.4	38.4	17	22
120.382	0.147	1985	8	7	5.4	70.4	6	24
122.229	0.802	1987	5	17	5.4	82.3	13	43
123.576	1.429	1990	4	19	5.4	33	8	28
123.566	1.462	1990	4	27	5.4	36.8	9	42
123.155	1.289	1990	8	4	5.4	36.1	9	19
124.146	1.093	1990	12	23	5.4	49.5	1	11
122.819	1.277	1991	6	21	5.4	26.9	12	14
123.045	1.093	1991	6	21	5.4	30	16	17
123.39	1.139	1992	9	23	5.4	32	8	10
123.171	0.895	1993	5	6	5.4	36.7	5	42
123.31	1.227	1993	6	4	5.4	27	11	24
123.238	-0.57	1994	4	9	5.4	29	1	29
120.559	1.17	1996	7	27	5.4	33	22	34
120.159	-2.19	1997	6	3	5.4	33	12	23
119.917	-0.46	2000	12	28	5.4	33	21	6
123.271	1.334	2002	3	17	5.4	33	8	28
121.958	-0.69	2003	1	28	5.4	10	11	29
121.824	1.236	2006	6	16	5.4	34.2	5	35
122.08	-2.63	2012	5	1	5.4	24.1	1	59
121.18	0.68	2017	3	14	5.4	79	5	55
120.17	0.27	2017	7	23	5.4	68.4	7	55
119.44	-2.92	2018	11	14	5.4	10	11	1
123.23	-0.61	2018	3	4	5.4	49.7	3	10
120.24	-1.58	2023	2	27	5.4	16	1	26
122.21	-0.56	2023	4	6	5.4	10	12	32
120.27	1.8	2023	10	28	5.4	21.1	3	1
119.09	-1.38	2013	4	13	5.4	73.4	1	37
122.57	-1.81	2019	4	12	5.4	10	11	50
123.53	-1.41	2019	11	1	5.4	10	2	32
123.71	-1.04	2019	12	16	5.4	10	12	40
122.84	1.6	2020	7	6	5.4	10	5	40
123.46	-2.11	2020	7	13	5.4	10	4	13
120.08	-3.21	2020	8	8	5.4	10	12	18
121.41	1.59	2020	8	30	5.4	10	1	34
124.01	1.57	2020	10	9	5.4	10	2	24
119.22	0.72	2020	11	18	5.4	10	11	14
120.92	-0.27	2020	11	27	5.4	10	1	47
119.96	-1.14	2021	4	23	5.4	10	6	34

124.16	-3.27	2021	5	7	5.4	10	10	29
120.38	0.56	2021	5	11	5.4	10	8	0
123.848	-0.15	1974	10	19	5.4	70	6	45
122.583	0.775	1975	3	17	5.4	64	18	58
122.6	0.838	1976	3	6	5.4	51	11	7
123.28	0.192	1977	11	6	5.4	33	17	17
120.6	-0.83	1977	11	27	5.4	65	9	33
121.654	-0.12	1983	7	17	5.4	52.3	22	10
119.727	-2.83	1986	5	27	5.4	35.7	7	58
123.441	1.229	1990	4	18	5.4	36.8	19	22
122.94	1.68	2014	2	18	5.4	30.5	3	34
119.92	-0.67	2018	9	28	5.4	14	10	39
122.974	1.249	1989	12	1	5.3	37.4	4	46
123.425	1.403	1990	12	14	5.3	33	11	46
120.918	-1.03	1995	4	29	5.3	33	16	45
121.941	0.748	1987	5	31	5.3	78.5	18	32
120.064	0.955	1990	4	22	5.3	33	23	51
123.59	1.329	1990	5	11	5.3	21.5	19	42
122.98	1.158	1990	6	26	5.3	31.1	2	36
124.178	-0.09	1990	7	5	5.3	72.4	22	41
124.003	1.021	1990	11	30	5.3	55.3	14	17
123.496	1.443	1991	5	13	5.3	31.5	3	41
122.706	1.409	1991	8	9	5.3	37.3	6	28
123.336	0.683	1992	1	6	5.3	58.4	14	28
123.361	1.228	1994	4	19	5.3	26	5	48
119.83	-2.95	1994	12	7	5.3	28	23	8
121.197	-2.37	1995	6	12	5.3	63.7	0	16
122.632	0.594	1995	8	26	5.3	33	17	11
120.202	0.988	1996	1	8	5.3	33	16	55
120.061	0.995	1996	8	20	5.3	33	3	28
120.157	1.488	1996	12	11	5.3	61.8	9	44
118.816	1.456	1998	12	29	5.3	33	21	34
120.836	1.263	2000	2	19	5.3	33	19	1
123.268	1.276	2001	2	9	5.3	33	17	2
122.361	-2.89	2001	11	3	5.3	33	21	50
119.69	-1.39	2002	5	30	5.3	33	12	45
120.217	-1.41	2002	7	1	5.3	43.1	8	11
120.145	-1.1	2005	1	23	5.3	28.9	19	59
120.164	-1.1	2005	1	23	5.3	22.9	21	2

122.639	-0.63	2008	6	4	5.3	46	1	25
122.15	1.33	2012	11	1	5.3	22.9	11	37
122.35	1.45	2013	9	9	5.3	40	9	41
122.19	-2.77	2020	6	15	5.3	10	11	36
123.3	-3.4	2020	12	2	5.3	19.7	8	36
122.2	1.24	2021	9	15	5.3	60.1	12	49
120.64	-1.31	2021	11	6	5.3	10	3	56
123.56	-0.72	2021	11	8	5.3	27.8	5	6
122.41	-0.91	2010	5	3	5.3	10	11	30
123.99	-0.38	2010	6	8	5.3	15	3	51
122.82	-2.71	2011	11	17	5.3	23.3	7	50
123.06	-2.07	2014	4	22	5.3	10	4	54
119.3	-0.03	2019	9	30	5.3	10	10	5
120.94	0.34	2020	5	23	5.3	10	2	26
124.28	-0.42	2020	6	8	5.3	85.3	2	34
120.51	1.64	2020	9	11	5.3	10	4	53
119.2	-2.09	2020	12	30	5.3	88.6	5	47
122.48	0.13	2021	1	11	5.3	10	1	8
122.56	1.013	1973	12	31	5.3	33	8	38
122.393	-0.41	1974	6	17	5.3	33	1	52
122.461	0.943	1975	3	15	5.3	38	16	4
122.46	0.841	1978	10	12	5.3	59	7	4
121.107	-2.12	1979	2	12	5.3	33	7	47
120.973	-2.31	1982	8	27	5.3	54.7	23	30
122.135	0.863	1984	10	26	5.3	44.4	8	7
122.819	1.182	1990	4	18	5.3	33	14	23
123.113	1.29	1990	4	18	5.3	28.6	15	27
123.429	1.215	1990	4	18	5.3	31.2	18	24
123.358	1.232	1990	4	18	5.3	28.5	18	54
123.492	-1.66	2000	5	4	5.3	33	4	50
123.49	1.26	2009	2	9	5.3	10	10	47
122.83	-0.26	2009	5	28	5.3	37.5	7	33
122.23	1.44	2012	11	6	5.3	49.9	1	42
122.96	-0.2	2013	11	22	5.3	81.7	5	37
119.56	0	2018	9	28	5.3	16.1	2	26
119.65	0.01	2018	10	1	5.3	15.9	5	43
119.729	-2.81	1990	5	9	5.2	33	19	46
123.497	1.355	1992	9	24	5.2	23.5	12	8
124.104	-0.23	1992	9	29	5.2	40	15	16

124.228	-0.67	1995	4	13	5.2	33	19	2
120.943	-0.32	1995	5	1	5.2	47.5	0	29
124.066	-0.64	1996	8	27	5.2	71.9	1	6
120.208	1.119	1996	9	10	5.2	33	6	20
120.135	1.006	1999	3	23	5.2	33	8	32
122.74	1.229	1999	12	17	5.2	39.8	12	38
121.906	-2.66	2000	5	7	5.2	33	20	33
119.922	-1.2	2001	11	30	5.2	38.3	15	22
119.938	0.8	2002	3	5	5.2	33	15	40
121.871	1.123	2002	7	11	5.2	56.7	17	30
124.171	0.129	2002	7	23	5.2	33	1	35
122.033	-0.71	2003	1	28	5.2	10	14	4
123.991	-0.11	2003	12	12	5.2	93.2	8	7
120.314	1.044	2004	9	26	5.2	27.5	15	24
119.702	0.192	2006	7	17	5.2	71.6	19	48
123.227	-0.41	2006	7	23	5.2	45.3	8	45
119.599	-1.51	2007	8	28	5.2	43.1	8	51
122	-2.58	2012	4	16	5.2	16.9	6	1
121.88	-2.63	2012	4	27	5.2	10	10	29
123.04	-0.18	2012	5	13	5.2	73.5	4	46
120.22	-1.09	2014	2	23	5.2	10.3	3	6
119.42	-2.42	2015	2	8	5.2	10	3	9
121.73	-2.63	2017	6	17	5.2	10.2	2	23
120.13	1.11	2021	5	29	5.2	25.3	1	25
120.39	0.05	2021	12	31	5.2	94.9	5	53
122.47	-0.65	2023	6	30	5.2	10	10	37
121.022	-2.51	1995	7	9	5.2	33	21	43
122.04	-1.01	2012	11	15	5.2	10	12	44
120.16	0.64	2016	3	6	5.2	10	2	54
121.35	1.13	2018	2	26	5.2	10	12	27
121.23	-0.06	2020	3	31	5.2	10	10	14
119.16	-0.13	2020	10	19	5.2	10	3	52
122.06	0.57	2020	11	18	5.2	10	4	14
122.84	-0.92	2021	1	5	5.2	10	12	32
121.2	-0.61	2021	1	6	5.2	5	4	56
122.99	1.66	2021	1	27	5.2	10	11	36
123.19	-1.73	2021	6	5	5.2	10	8	56
123.57	-0.44	2023	3	28	5.2	49.9	4	19
123.034	0.064	1973	11	15	5.1	33	20	39

120.811	0.144	1974	2	5	5.1	43	21	59
123.348	1.345	1979	5	2	5.1	33	12	44
121.461	-1.65	1979	5	12	5.1	46	9	9
123.001	-0.16	1980	8	31	5.1	97	16	29
121.741	-0.08	1983	7	17	5.1	60.5	19	4
121.7	-0.09	1983	7	18	5.1	66.2	3	14
121.596	-0.07	1983	7	18	5.1	67.5	5	28
121.751	-0.1	1983	7	18	5.1	63	7	27
121.478	-0.2	1983	7	23	5.1	31.5	8	29
120.074	0.684	1983	7	26	5.1	44.9	20	14
120.123	0.664	1983	7	31	5.1	33	4	8
122.934	-0.38	1985	7	14	5.1	96.3	4	17
122.999	1.212	1990	4	18	5.1	33	14	19
123.039	1.321	1990	4	18	5.1	33	14	29
122.973	1.319	1990	4	18	5.1	33	15	15
123.463	1.188	1990	4	19	5.1	28.1	3	59
123.714	1.096	1990	12	12	5.1	33	18	24
123.981	1.05	1990	12	13	5.1	33	12	41
122.46	0.516	1991	6	17	5.1	97	5	9
120.505	-1.04	1995	5	19	5.1	33	21	35
120.864	0.582	1999	10	26	5.1	33	18	40
119.9	0.42	2009	1	2	5.1	10	7	54
122.96	-3.09	2009	3	29	5.1	10	10	35
119.87	-0.66	2018	10	1	5.1	11.1	11	46
121.74	-0.8	2009	10	2	5.1	10	3	53
122.323	-0.79	1990	4	4	5.1	32.6	9	7
122.761	-0.29	1990	7	17	5.1	94.8	4	5
123.23	1.412	1990	12	17	5.1	33	1	21
122.643	1.331	1991	8	8	5.1	33	22	8
123.607	0.474	1995	9	13	5.1	28.2	1	16
120.891	1.253	1996	8	12	5.1	33	15	44
123.905	-0.91	1997	8	30	5.1	40.7	13	2
120.411	1.39	1998	7	24	5.1	49.8	10	51
123.227	-0.55	2000	5	11	5.1	77	21	38
123.467	-1.3	2000	5	16	5.1	66.2	20	16
121.628	-0.82	2001	5	8	5.1	33	12	14
120.32	-1.6	2002	2	14	5.1	19.2	13	14
123.192	-0.57	2002	4	30	5.1	33	23	1
123.641	-1.18	2002	12	14	5.1	33	9	57

123.583	-0.53	2003	6	12	5.1	54.9	19	41
121.295	-2.74	2003	11	5	5.1	33	22	2
120.179	0.965	2004	10	25	5.1	28.9	7	15
123.722	-0.06	2005	7	31	5.1	94.3	22	6
123.305	-0.4	2006	6	30	5.1	51.3	2	49
122.781	1.339	2006	8	28	5.1	10	19	26
123.183	-3.66	2007	5	6	5.1	30	1	3
122.098	-0.56	2007	7	2	5.1	27.7	10	40
120.642	0.21	2007	12	6	5.1	83.2	13	59
122.5	-0.87	2010	5	3	5.1	10	11	30
122.79	-0.24	2012	7	9	5.1	58.3	12	25
122.39	1.45	2013	9	10	5.1	21.3	1	12
119.95	0.13	2014	9	23	5.1	56.6	10	22
120.08	1.16	2018	5	18	5.1	44.1	8	26
119.44	-2.91	2018	11	5	5.1	10	6	35
120.09	1.07	2021	2	14	5.1	47.7	9	44
119.46	-2.94	2021	7	21	5.1	10	5	44
124.04	-0.32	2021	11	3	5.1	64.2	2	11
122.85	-0.17	2022	7	20	5.1	78.1	5	31
122.66	-2.41	2022	7	29	5.1	10	4	31
121.06	0.47	2023	2	14	5.1	97.7	6	2
120.25	-1.09	2023	8	6	5.1	10	10	9
121.21	-0.69	2023	8	12	5.1	10	1	20
122.22	1.23	2010	4	30	5.1	10	11	21
119.32	-1.55	2010	6	16	5.1	10	12	52
123.67	-1.28	2010	6	17	5.1	36.9	4	35
119.4	0.86	2010	10	13	5.1	10	9	4
122.93	-2.15	2010	12	16	5.1	10	10	40
121.78	0.98	2011	7	1	5.1	10	2	38
119.08	-1.09	2012	9	4	5.1	69.3	1	38
119.32	-0.52	2015	3	19	5.1	59.2	3	56
122.63	-2.14	2019	4	12	5.1	76.1	12	4
121.33	-0.8	2019	12	10	5.1	10	6	47
119.51	0.56	2021	1	2	5.1	10	7	29
120.28	-2.17	2021	3	12	5.1	76.6	4	55
121.87	-1.69	2021	5	13	5.1	10	1	41
123.28	1.38	2022	11	12	5.1	10	11	1
119.837	-2.71	1973	2	9	5.0	33	5	2
121.944	0.045	1976	1	17	5.0	77	7	4

120.316	-1.88	1976	12	29	5.0	38	18	46
120.779	-2.24	1977	2	7	5.0	33	2	24
120.591	-0.86	1977	7	15	5.0	58	3	23
124.097	-0.07	1978	2	7	5.0	33	7	18
124.261	-0.12	1978	5	8	5.0	94	22	32
122.446	0.988	1978	5	22	5.0	34	3	17
124.061	-0.15	1978	12	13	5.0	96	0	21
122.76	1.329	1979	8	24	5.0	44	2	13
121.656	-0.09	1983	7	17	5.0	54.2	11	40
121.721	-0.08	1983	7	18	5.0	72.1	13	40
121.782	0.116	1983	7	19	5.0	33	10	44
121.699	-0.09	1983	8	1	5.0	57.7	11	14
120.399	1.113	1983	11	14	5.0	33	21	26
120.866	1.253	1983	11	23	5.0	17.2	18	39
118.792	-2.75	1984	6	25	5.0	38.2	5	12
119.736	-2.86	1985	1	28	5.0	33	23	17
119.765	-2.18	1985	2	24	5.0	55.9	2	40
119.675	-2.22	1985	2	24	5.0	42.5	13	7
119.692	-2.21	1985	3	12	5.0	47.8	6	12
119.879	0.781	1986	1	5	5.0	33	23	3
124.318	-0.57	1986	4	14	5.0	42.9	9	44
123.359	1.305	1990	4	18	5.0	33	19	8
121.468	1.132	1990	7	8	5.0	39.1	23	27
124.12	1.175	1990	12	13	5.0	33	19	28
119.849	0.151	1992	4	30	5.0	29.1	17	55
120.446	1.313	1993	9	23	5.0	33	2	52
120.154	1.005	1996	1	27	5.0	33	19	14
119.663	0.401	2002	1	11	5.0	33	11	17
120.718	-1	2007	11	6	5.0	35	14	10
123.67	0.02	2009	3	18	5.0	99.2	5	8
123.42	0.96	2009	10	17	5.0	29.9	12	52
123.26	0.97	2010	2	26	5.0	50.7	4	41
122.27	-0.58	2015	3	18	5.0	10	1	22
122.44	-2.81	2015	7	28	5.0	31.3	2	38
123.01	-0.19	2017	2	10	5.0	73.7	6	28
119.99	-1.26	2017	11	25	5.0	10	11	11
120.02	-1.51	2018	9	28	5.0	14.3	11	6
120.17	-1.56	2018	9	28	5.0	10	9	24
120.18	-1.57	2018	10	2	5.0	10	4	59

120.2	-1.67	2018	10	22	5.0	20.2	4	7
119.43	-2.91	2018	11	7	5.0	10	9	42
124.117	-0.04	1996	12	14	5.0	83.2	18	5
122.811	-0.46	2000	9	18	5.0	71.2	11	28
123.055	-0.23	2002	6	12	5.0	87.6	6	27
122.758	1.226	2004	1	7	5.0	43.9	21	57
120.059	-0.4	2006	1	3	5.0	30	11	0
123.064	-0.77	2006	2	7	5.0	60.5	17	56
119.731	-0.29	2008	8	21	5.0	56.8	21	30
121.99	1.42	2009	1	1	5.0	10	10	35
119.94	-1.11	2011	1	8	5.0	10	8	15
123.19	0.97	2019	4	7	5.0	55.3	7	45
122.15	1	2019	5	21	5.0	62.1	6	42
122.06	1.44	2020	3	22	5.0	47.5	3	34
122.23	-2.78	2021	1	3	5.0	10	7	13
120.07	1.06	2021	1	11	5.0	50.8	1	57
120.81	1.29	2009	10	31	5.0	8.6	12	14
122.41	0.62	2017	12	15	5.0	74.1	9	27
120.25	-1.12	2023	8	6	5.0	10	1	44
121.49	0.72	2023	8	10	5.0	69.7	6	14
121.37	-2.38	2010	1	5	5.0	18.3	2	36
123.24	0.65	2010	6	17	5.0	34.1	10	7
120.59	-1.39	2010	7	24	5.0	24.2	11	51
123.37	0.79	2011	1	10	5.0	50	8	35
119.86	-0.17	2011	6	13	5.0	10	8	40
121.29	1.22	2012	2	6	5.0	10	4	2
119.11	-2.63	2012	8	3	5.0	10	3	0
123.66	-1.71	2013	11	7	5.0	10	10	5
123.81	-0.49	2015	2	15	5.0	15.5	6	29
121.86	-0.49	2018	3	16	5.0	10	1	30
119.82	-1.41	2018	9	29	5.0	10	2	31
121.8	1.17	2019	8	1	5.0	49.7	8	35
120.76	-2.4	2020	7	17	5.0	10	7	17
120.08	-1.01	2020	9	19	5.0	10	6	19
119.18	1.3	2020	10	15	5.0	10	4	41
120.36	1.17	2020	10	15	5.0	10	11	52
120.43	-2.42	2021	4	13	5.0	10	7	51
119.28	-2.29	2021	9	26	5.0	10.1	9	32

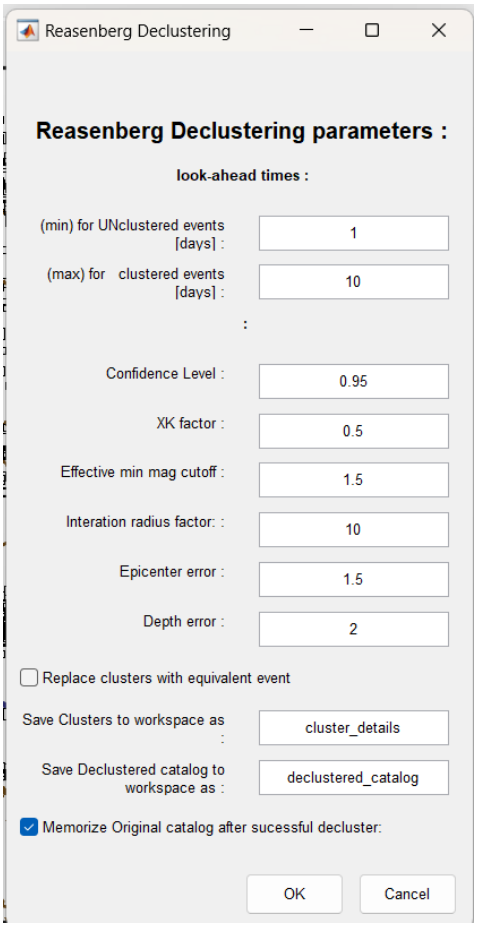
Lampiran 2. Konversi tipe magnitudo

Berikut ini contoh perhitungan konversi Mb ke Mw menggunakan persamaan 2.1:

$$Mw = 1.1993(M_B) - 1.2261$$

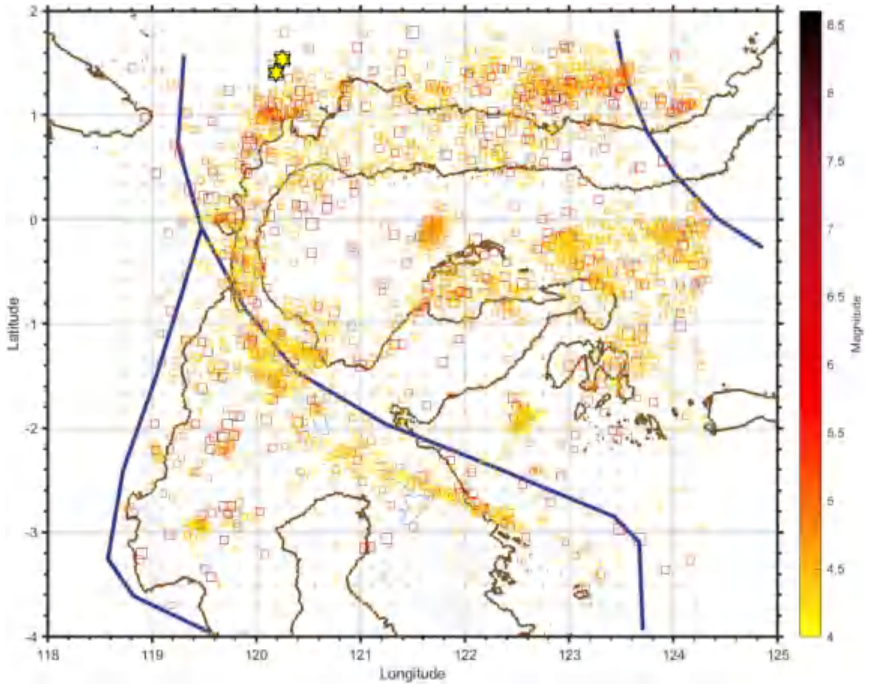
Origin Time	Mag.	Type	Lat.	Long.	Depth	Region	Mw
2004-08-15T11:14:51.850Z	4.7	mb	-0.722	119.937	50.6	21 km NNE of Palu, Indonesia	4.4
2004-08-15T11:14:51.850Z	4.7	mb	-0.722	119.937	50.6	21 km NNE of Palu, Indonesia	4.4
2005-02-16T21:50:32.880Z	4.7	mb	-1.493	119.746	6.7	66 km SSW of Palu, Indonesia	4.41061
2005-02-21T04:00:24.890Z	4.4	mb	-0.848	119.619	87.9	28 km WNW of Palu, Indonesia	4.05082
2005-03-04T04:49:21.020Z	4.4	mb	0.533	119.809	54.4	159 km N of Palu, Indonesia	4.05082
2005-03-10T22:10:33.950Z	4.4	mb	-1.373	119.82	75.8	51 km S of Palu, Indonesia	4.050

Lampiran 3. Parameter *Input Declustering Reasenberg*

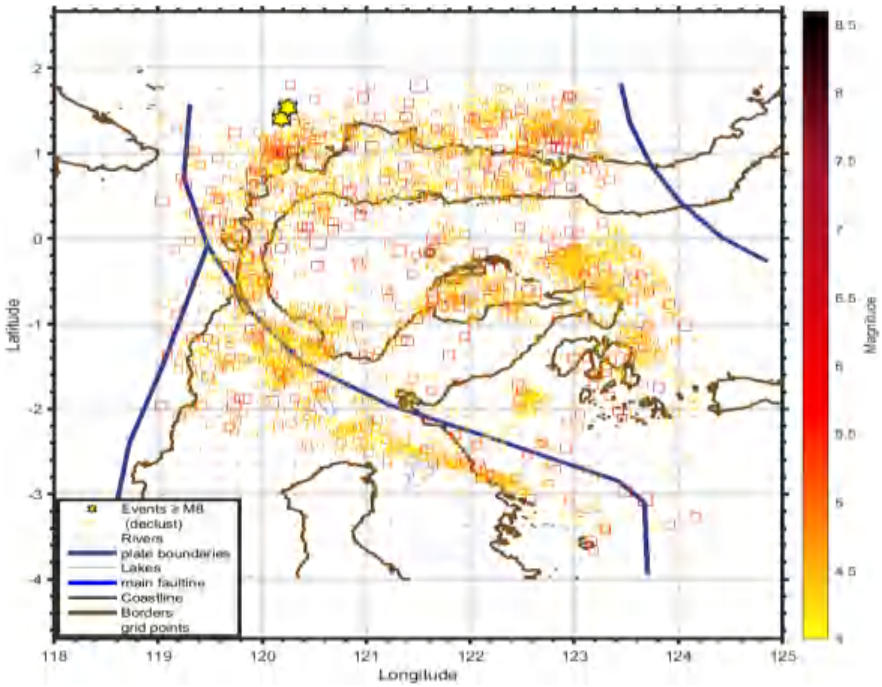


Lampiran 4. *Filtering* dan *Declustering*

- Sebelum

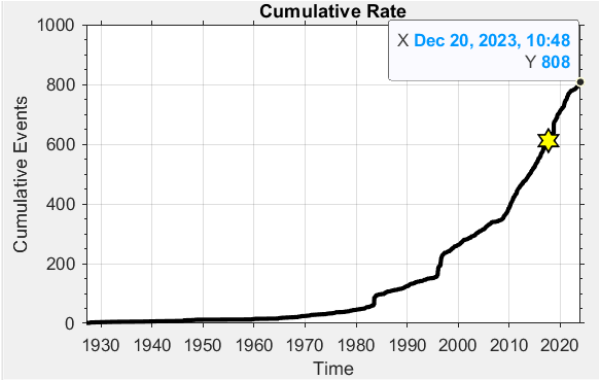


- Sesudah

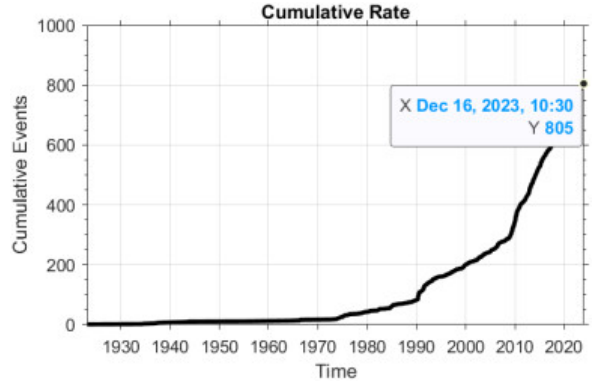


Lampiran 5. Grafik jumlah *events* gempa bumi terhadap waktu

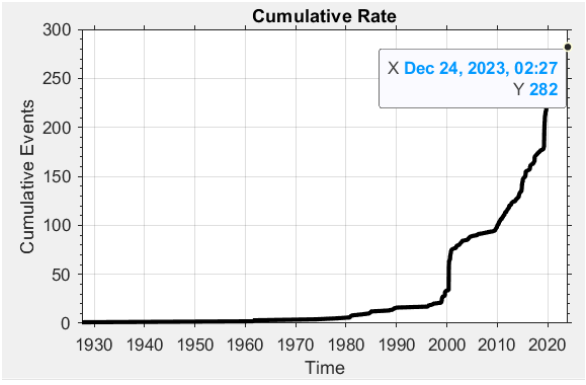
- Wilayah 1



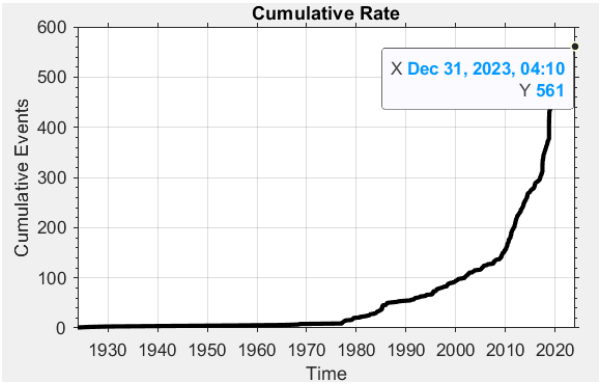
- Wilayah II



- Wilayah III



- Wilayah 1V



Lampiran 6. Perhitungan Periode Ulang (contoh pada Mw≥4)

D3 =B3-LOG(C3*2.3)

	A	B	C	D	E	F	G	H
1	M=4							
2	**Wilayah**	**a-value**	**b-value**	**A**	**A1**	**N1(M=4)**	**P. ULANG**	**hari**
3	I	5.785	0.7	5.57817	3.57817	6.000316019	0.166657889	59.9968
4	II	6.365	0.84	6.07899	4.07899	5.2359185	0.190988458	68.7558
5	III	5.765	0.81	5.49479	3.49479	1.797989475	0.556176782	200.224
6	IV	6.574	0.93	6.24379	4.24379	3.34032878	0.299371728	107.774

E3 =D3-LOG(100)

	A	B	C	D	E	F	G	H
1	M=4							
2	**Wilayah**	**a-value**	**b-value**	**A**	**A1**	**N1(M=4)**	**P. ULANG**	**hari**
3	I	5.785	0.7	5.57817	3.57817	6.000316019	0.166657889	59.9968
4	II	6.365	0.84	6.07899	4.07899	5.2359185	0.190988458	68.7558
5	III	5.765	0.81	5.49479	3.49479	1.797989475	0.556176782	200.224
6	IV	6.574	0.93	6.24379	4.24379	3.34032878	0.299371728	107.774

F3 =10^(E3-4*C3)

	A	B	C	D	E	F	G	H
1	M=4							
	ah	**a-value**	**b-value**	**A**	**A1**	**N1(M=4)**	**P. ULANG**	**hari**
		5.785	0.7	5.57817	3.57817	6.000316019	0.166657889	59.9968
		6.365	0.84	6.07899	4.07899	5.2359185	0.190988458	68.7558
		5.765	0.81	5.49479	3.49479	1.797989475	0.556176782	200.224
		6.574	0.93	6.24379	4.24379	3.34032878	0.299371728	107.774

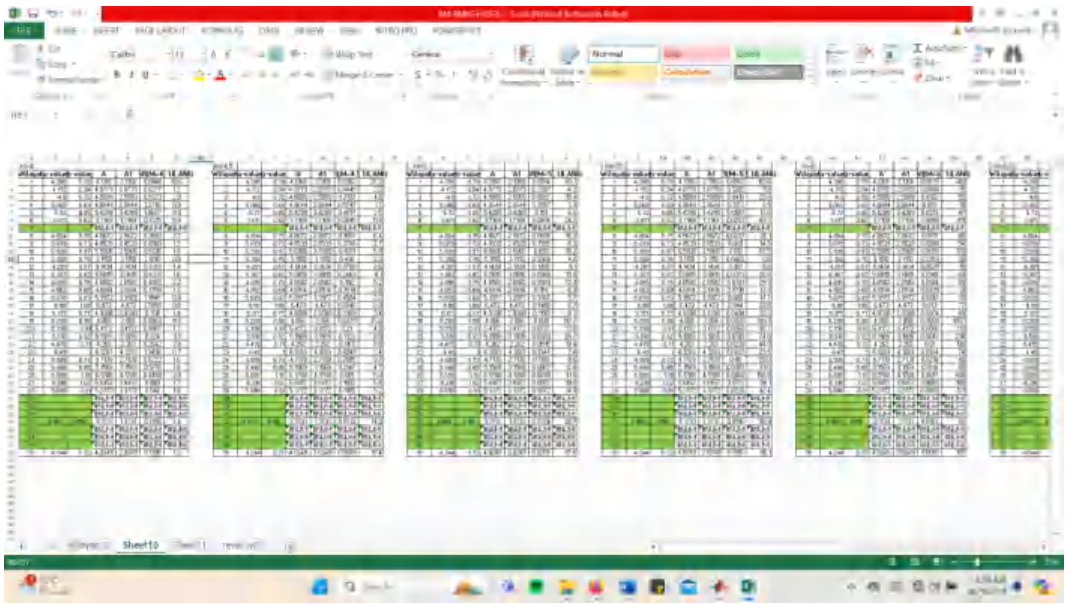
G3 =1/F3

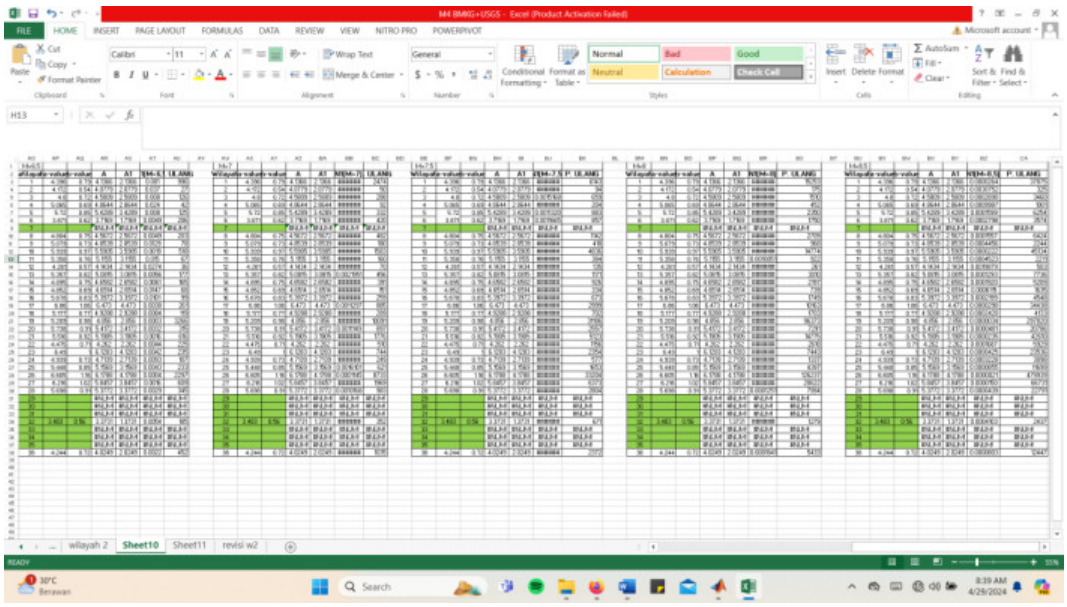
	A	B	C	D	E	F	G	H
1	M=4							
2	**Wilayah**	**a-value**	**b-value**	**A**	**A1**	**N1(M=4)**	**P. ULANG**	**hari**
3	I	5.785	0.7	5.57817	3.57817	6.000316019	0.166657889	59.9968
4	II	6.365	0.84	6.07899	4.07899	5.2359185	0.190988458	68.7558
5	III	5.765	0.81	5.49479	3.49479	1.797989475	0.556176782	200.224
6	IV	6.574	0.93	6.24379	4.24379	3.34032878	0.299371728	107.774

H3 =G3*12*30

	A	B	C	D	E	F	G	H
1	M=4							
2	**Wilayah**	**a-value**	**b-value**	**A**	**A1**	**N1(M=4)**	**P. ULANG**	**hari**
3	I	5.785	0.7	5.57817	3.57817	6.000316019	0.166657889	59.9968
4	II	6.365	0.84	6.07899	4.07899	5.2359185	0.190988458	68.7558
5	III	5.765	0.81	5.49479	3.49479	1.797989475	0.556176782	200.224
6	IV	6.574	0.93	6.24379	4.24379	3.34032878	0.299371728	107.774

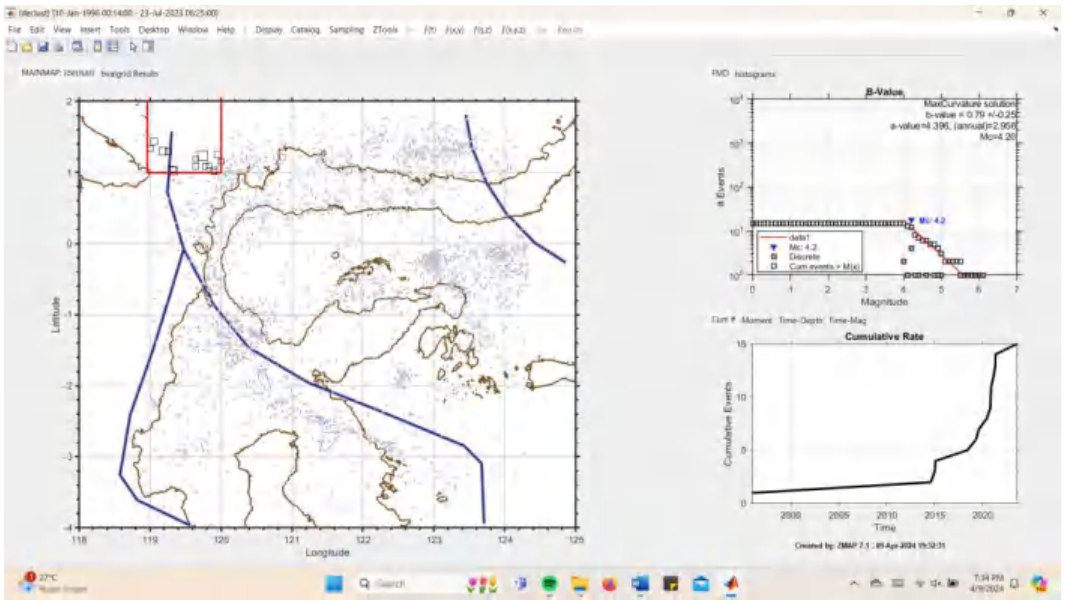
Lampiran 7. Perhitungan Periode Ulang 36 Daerah di Ms Excel



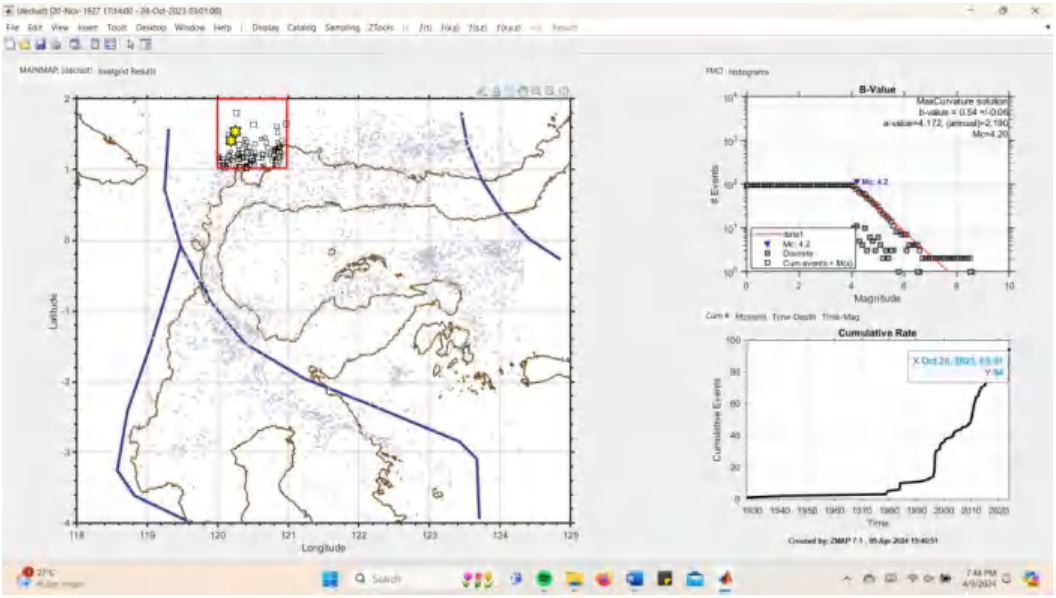


Lampiran 8. Grafik 36 Daerah pembagian di Sulawesi Tengah dan sekitarnya

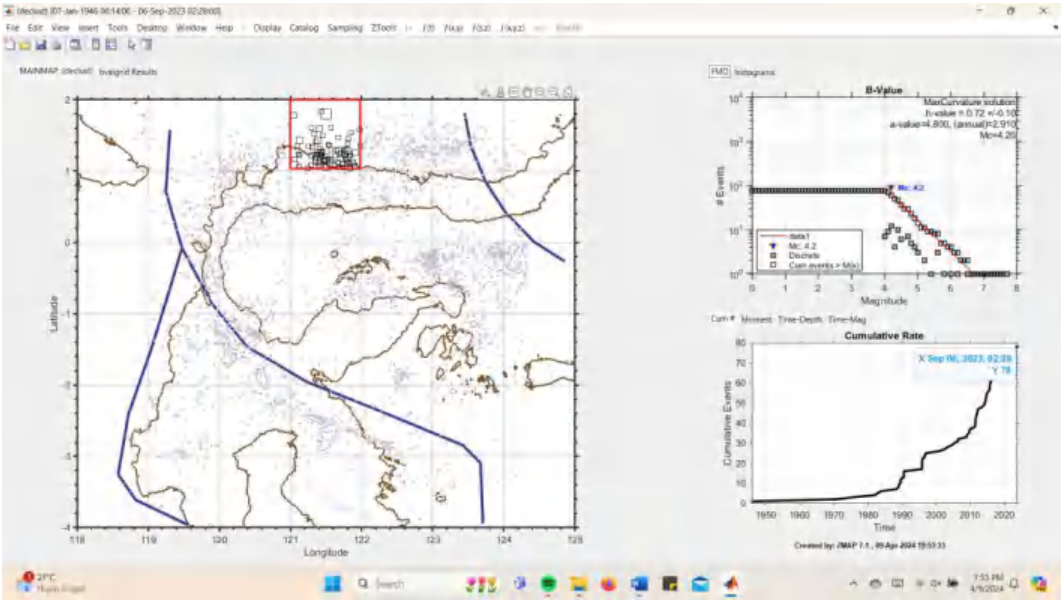
Daerah 1



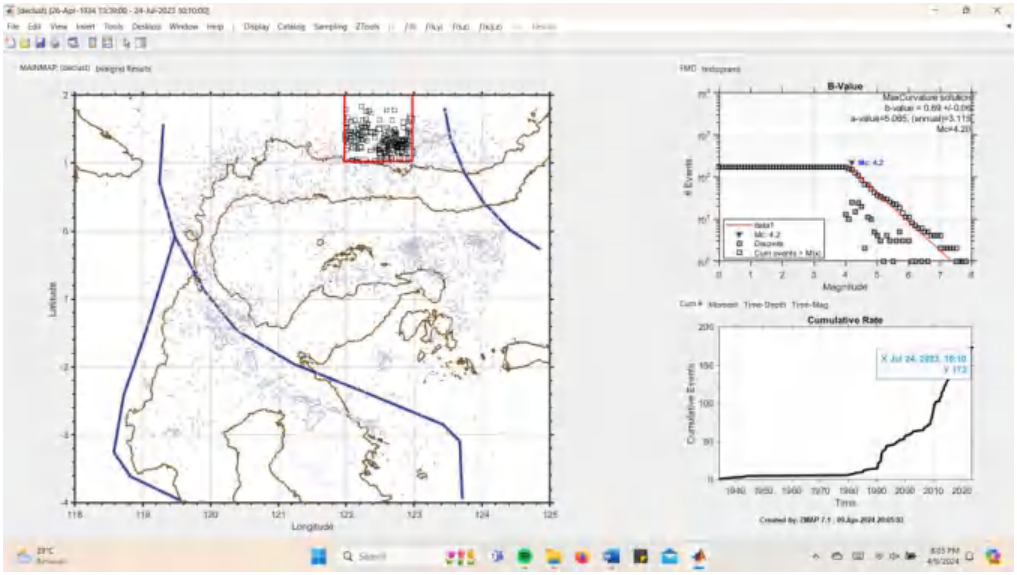
Daerah 2



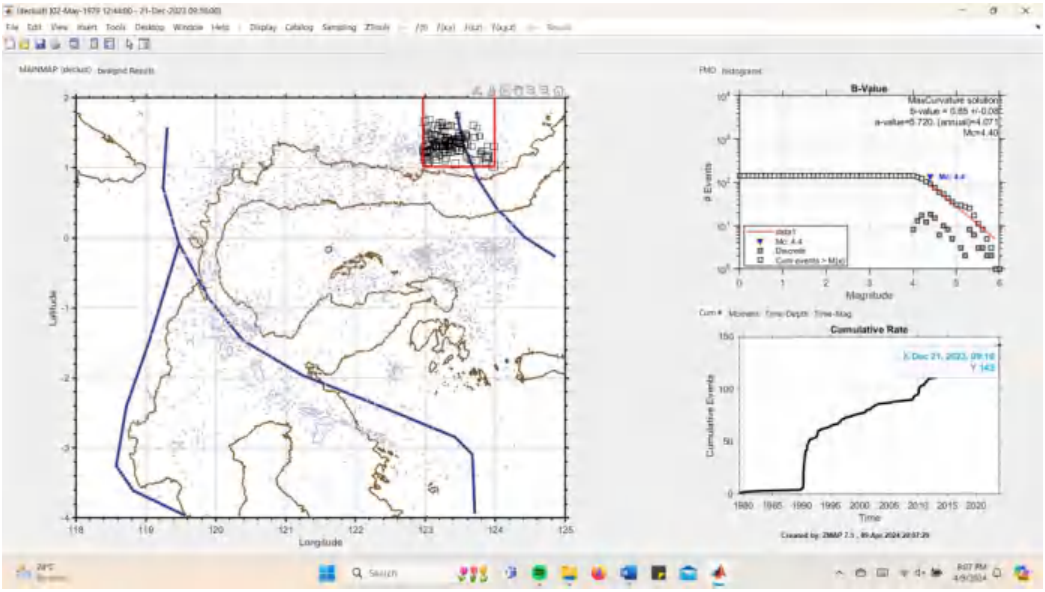
Daerah 3



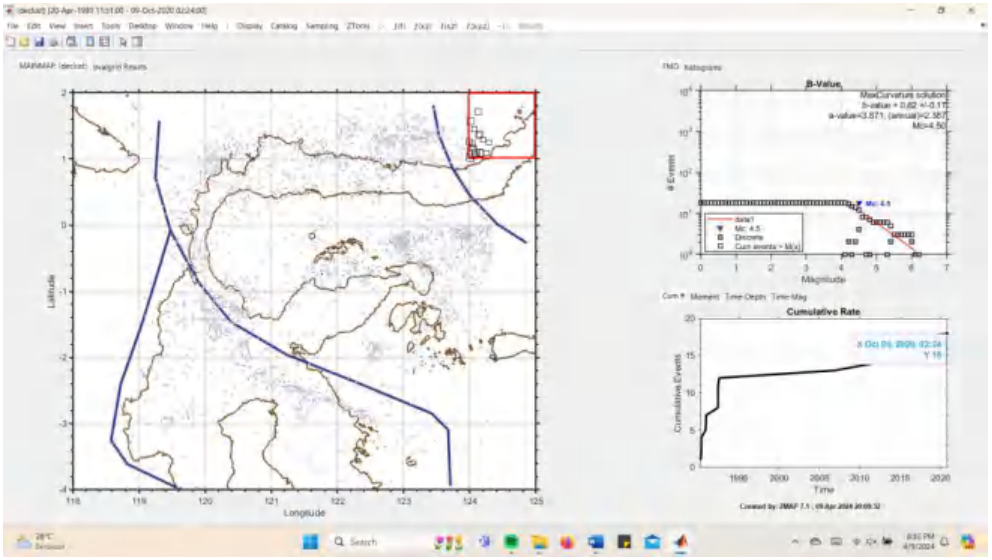
Daerah 4



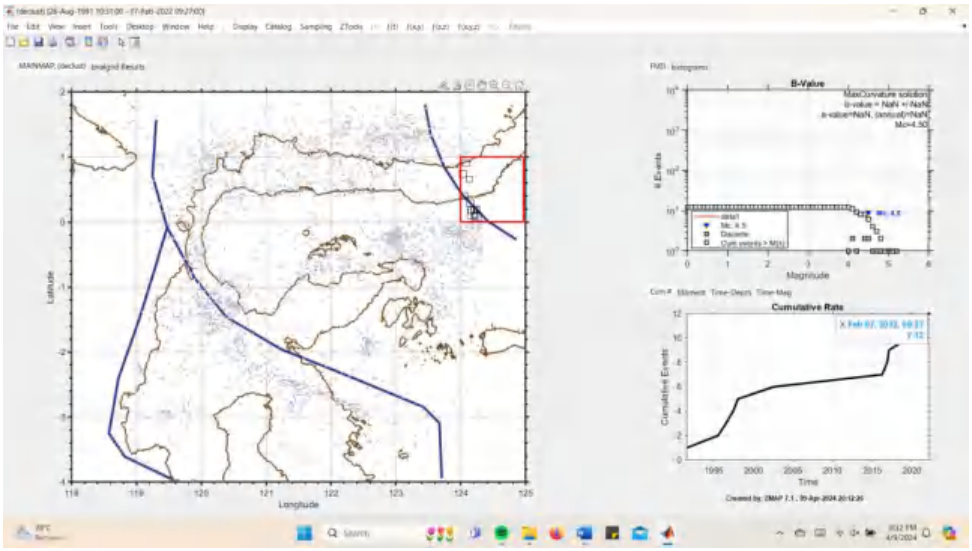
Daerah 5



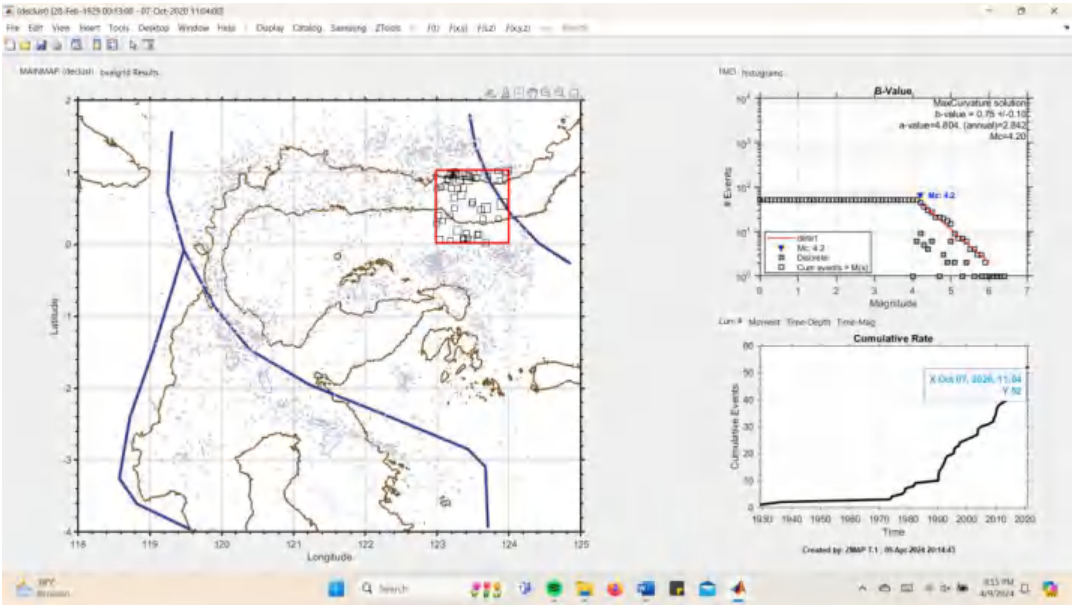
Daerah 6



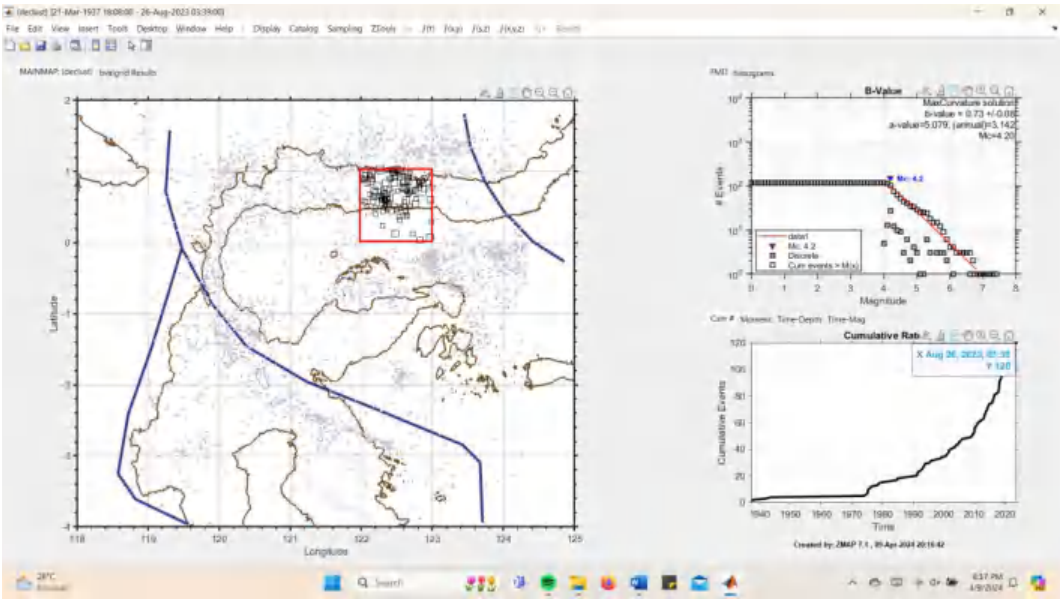
Daerah 7



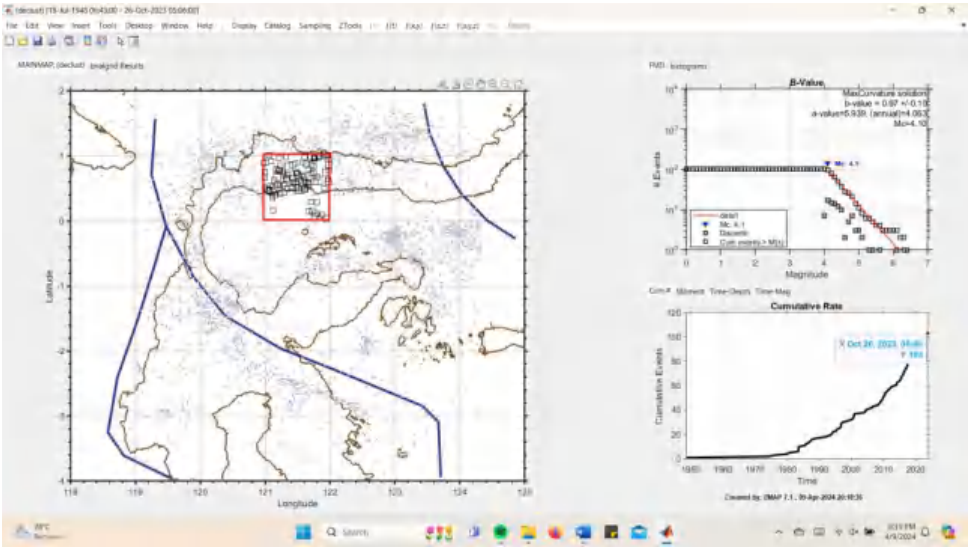
Daerah 8



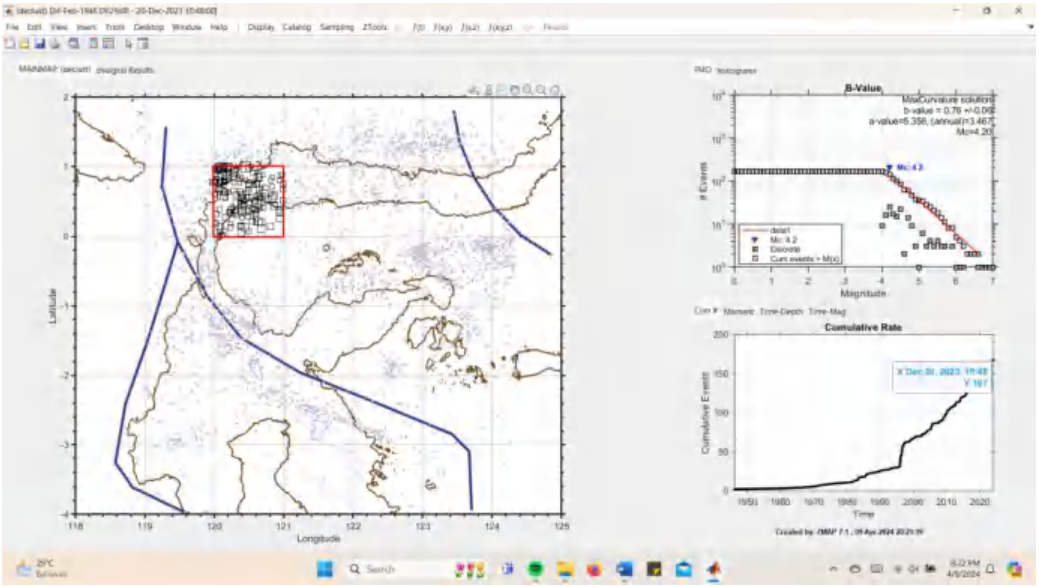
Daerah 9



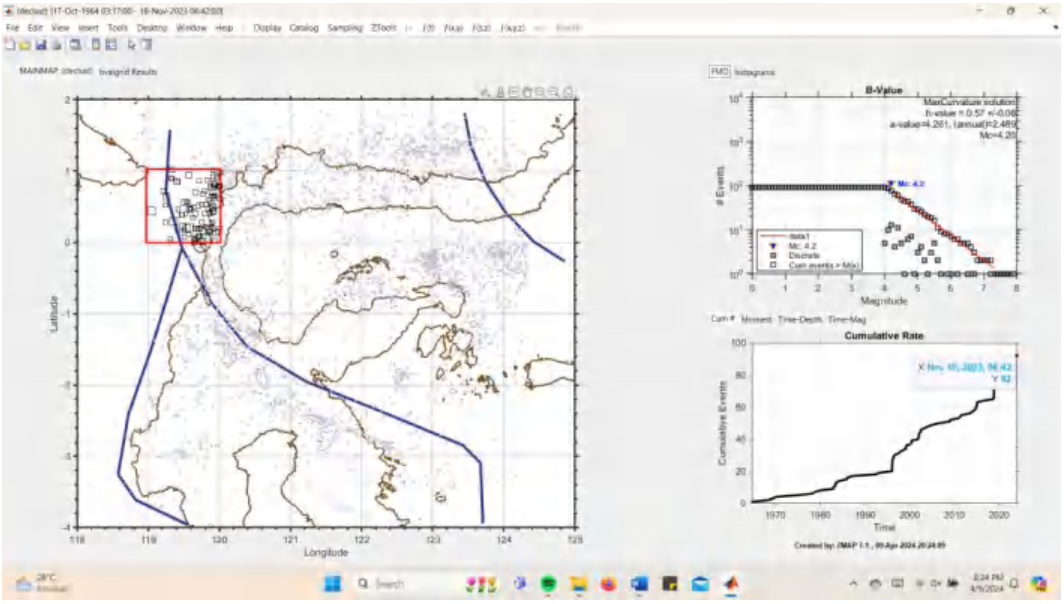
Daerah 10



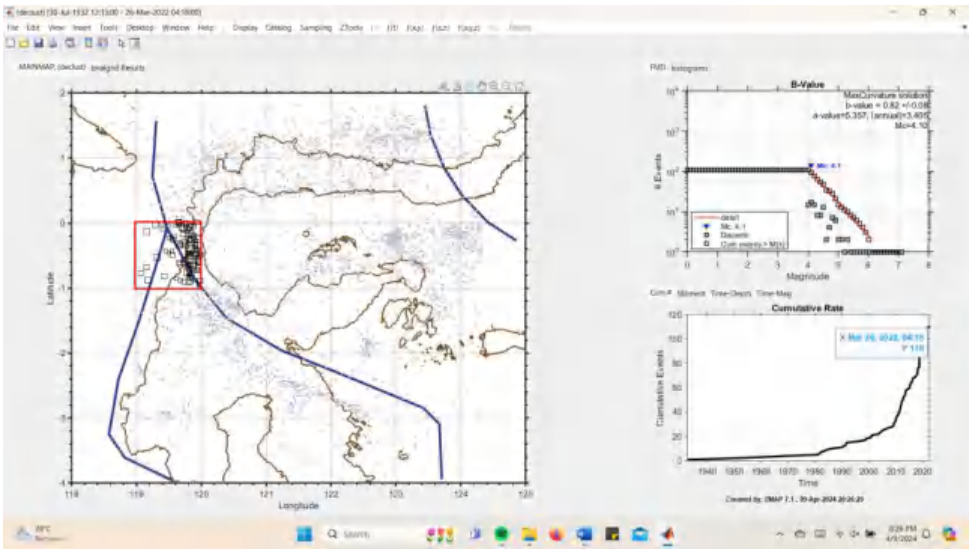
Daerah 11



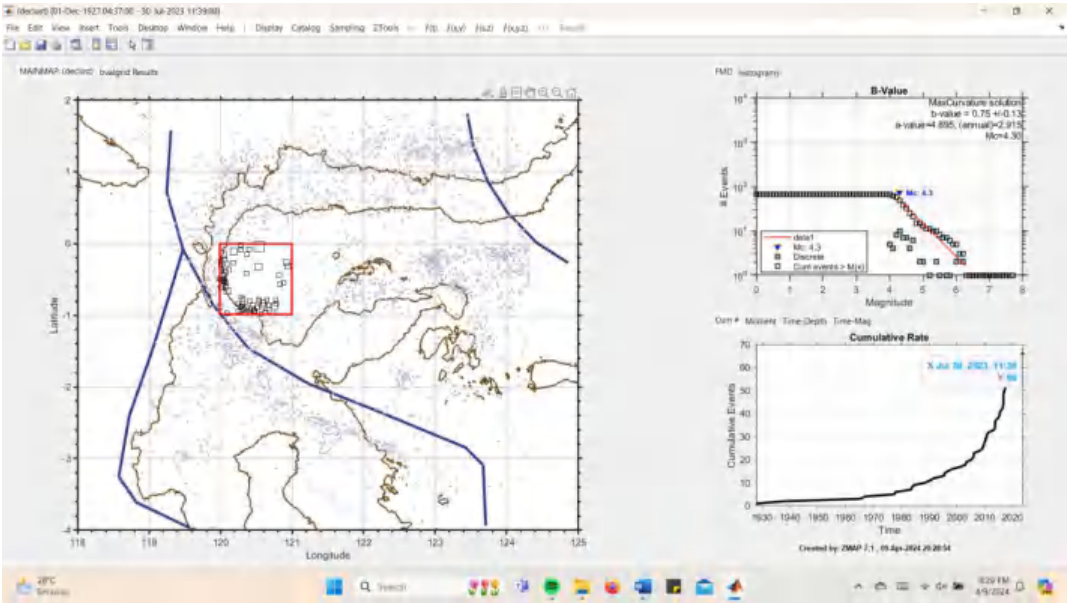
Daerah 12



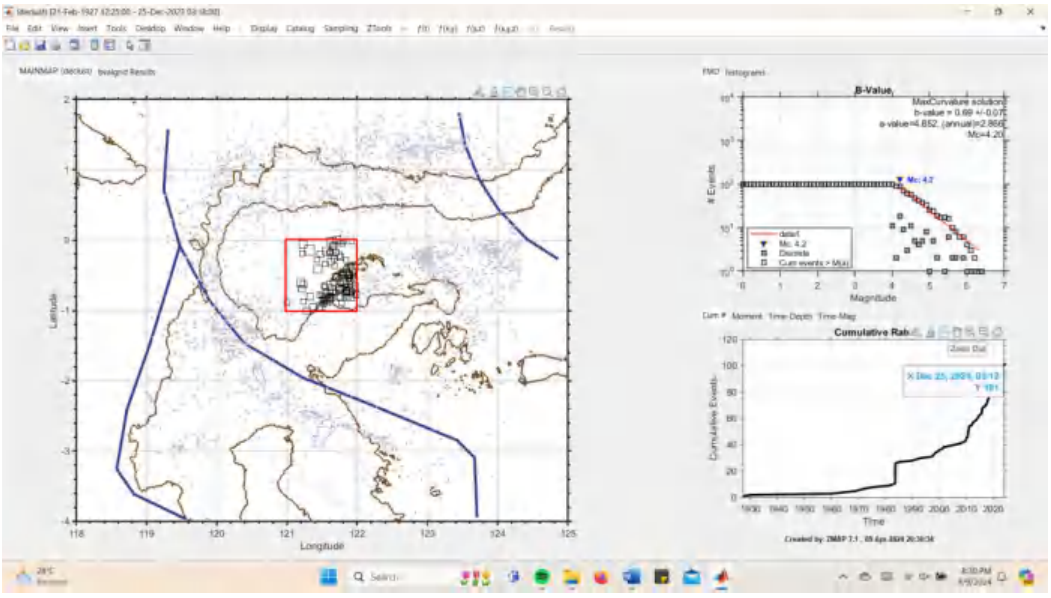
Daerah 13



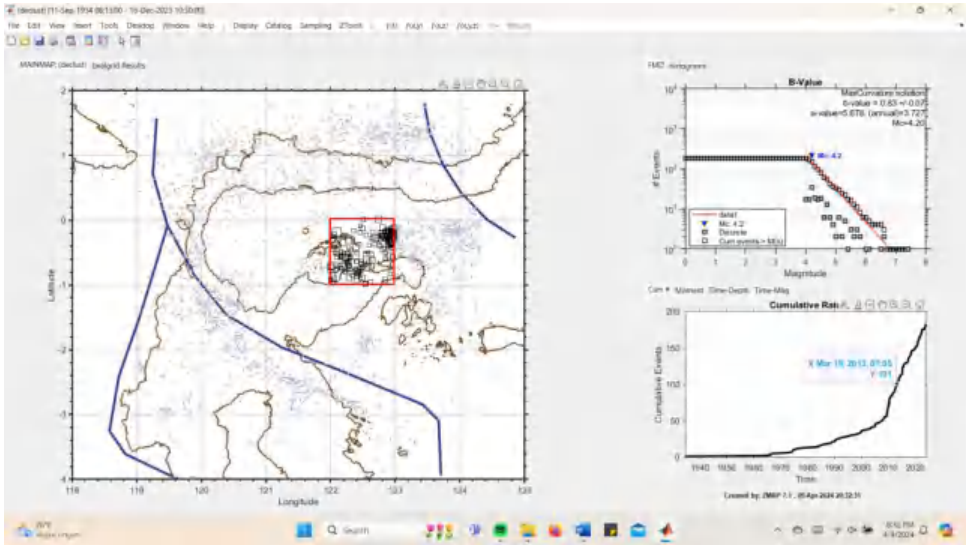
Daerah 14



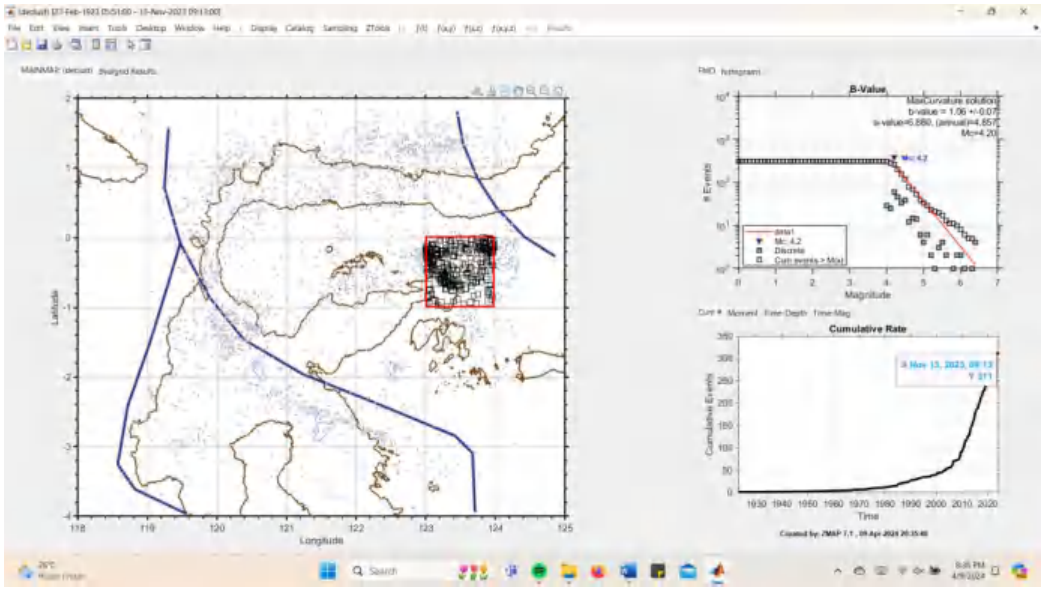
Daerah 15



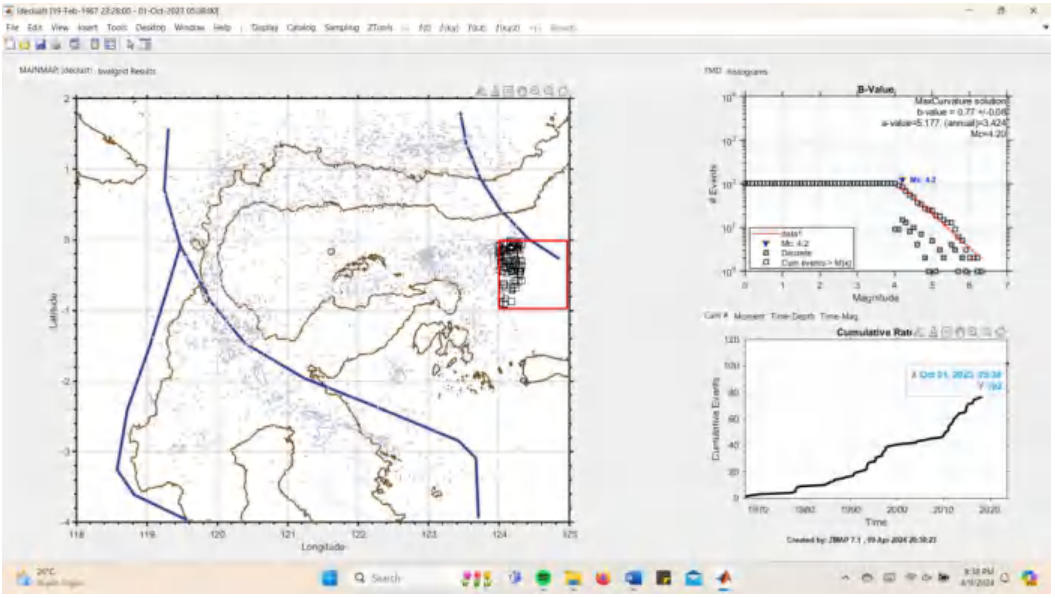
Daerah 16



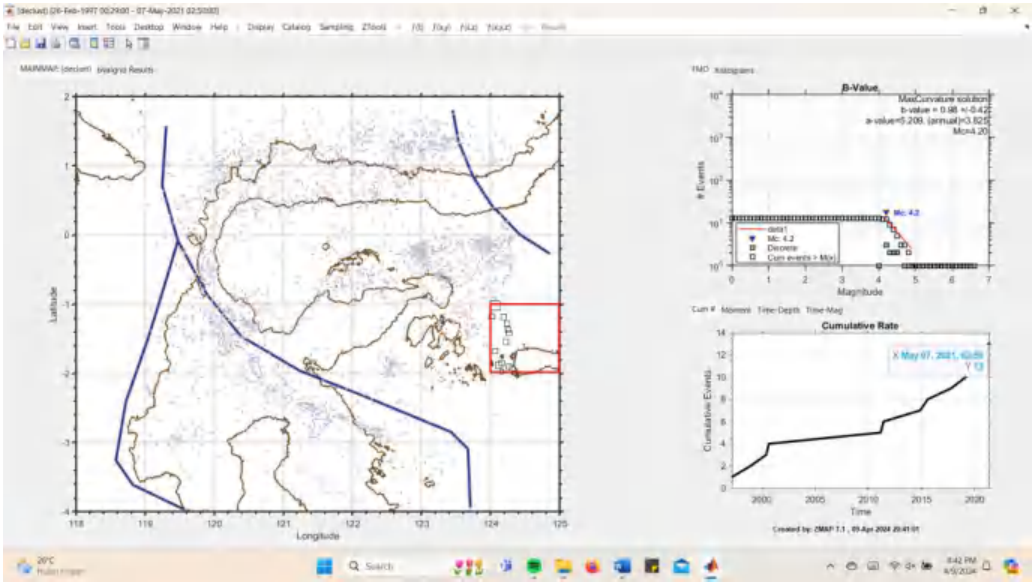
Daerah 17



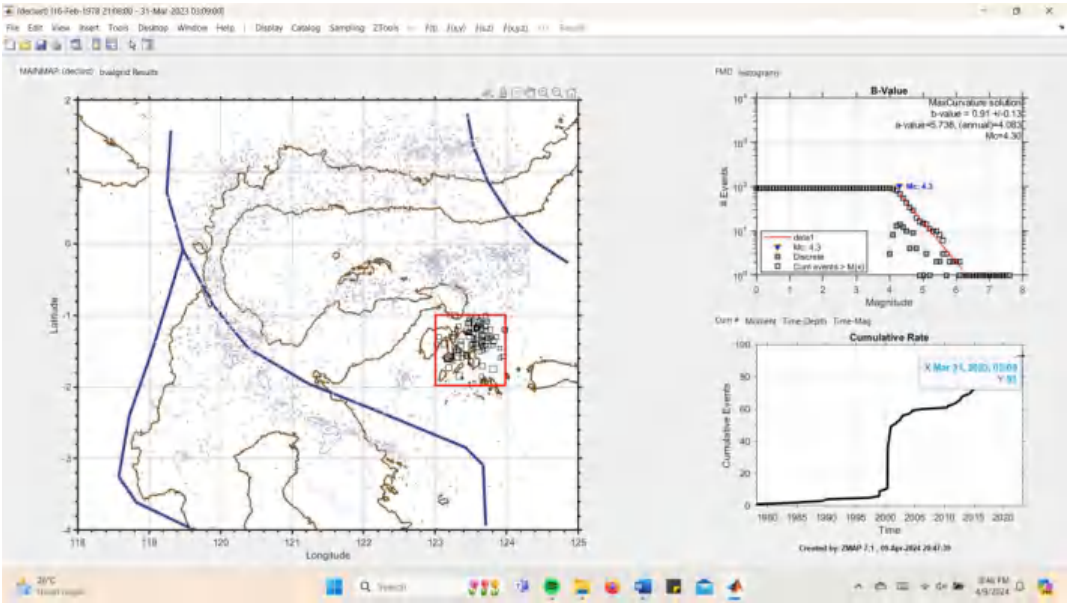
Daerah 18



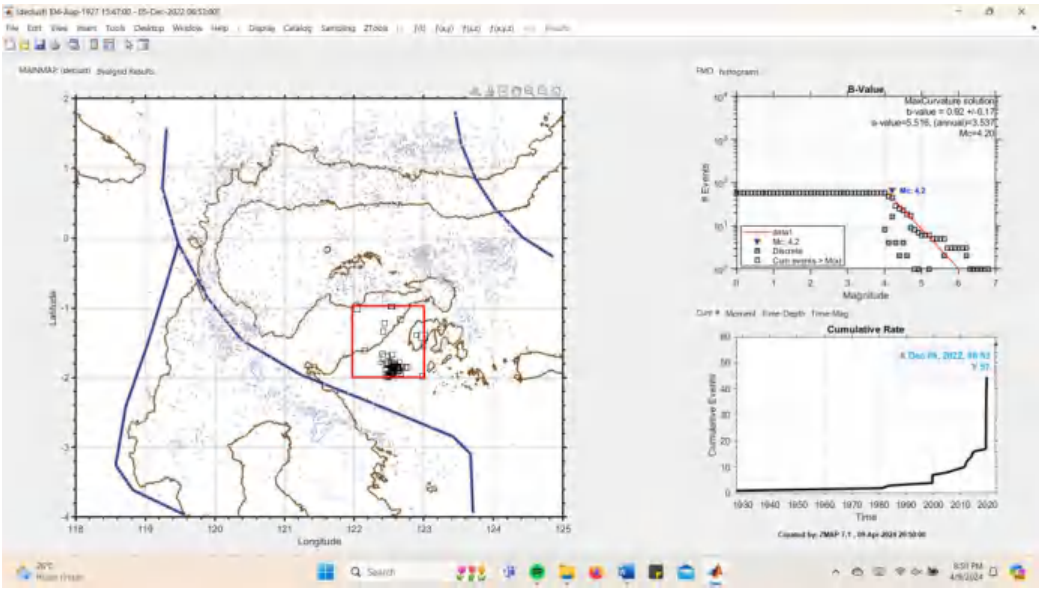
Daerah 19



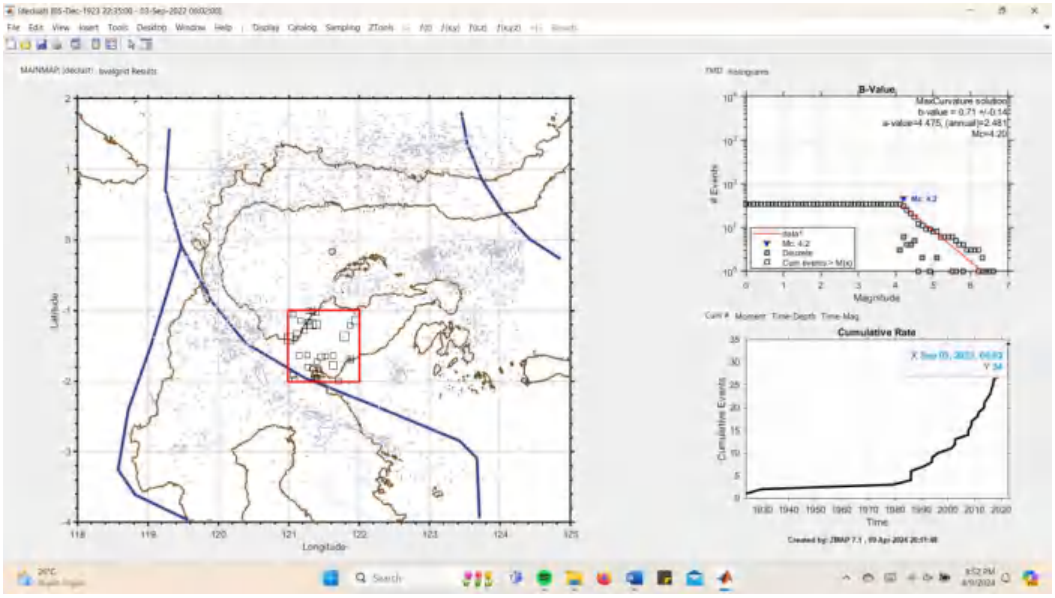
Daerah 20



Daerah 21



Daerah 22



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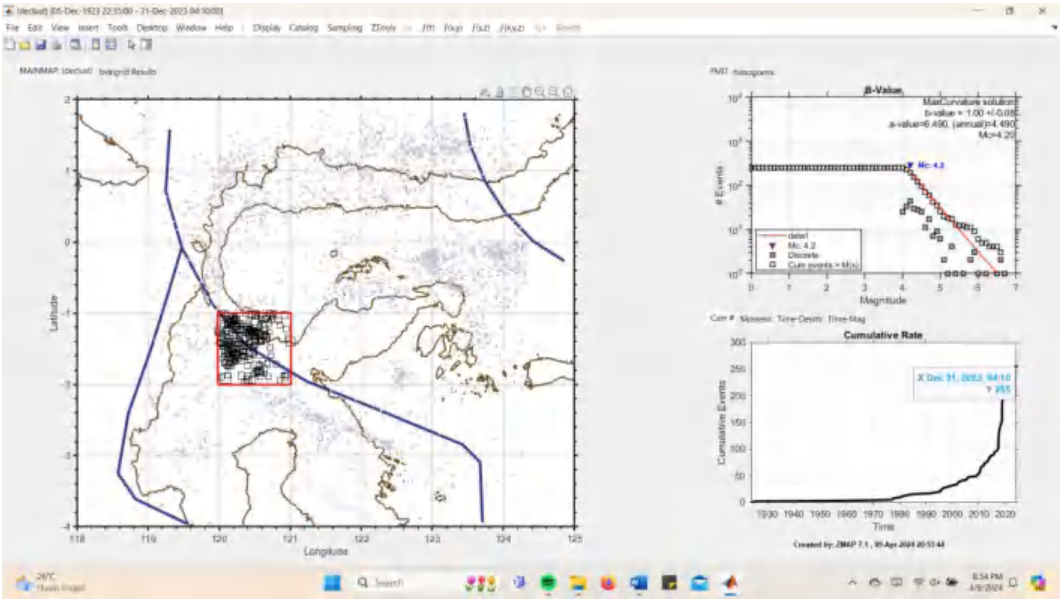

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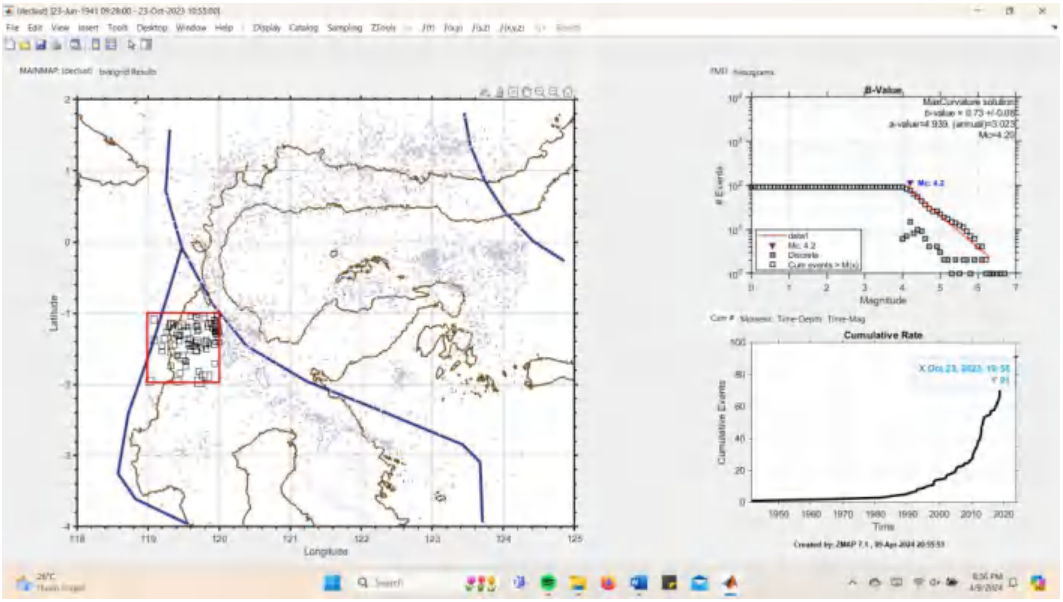

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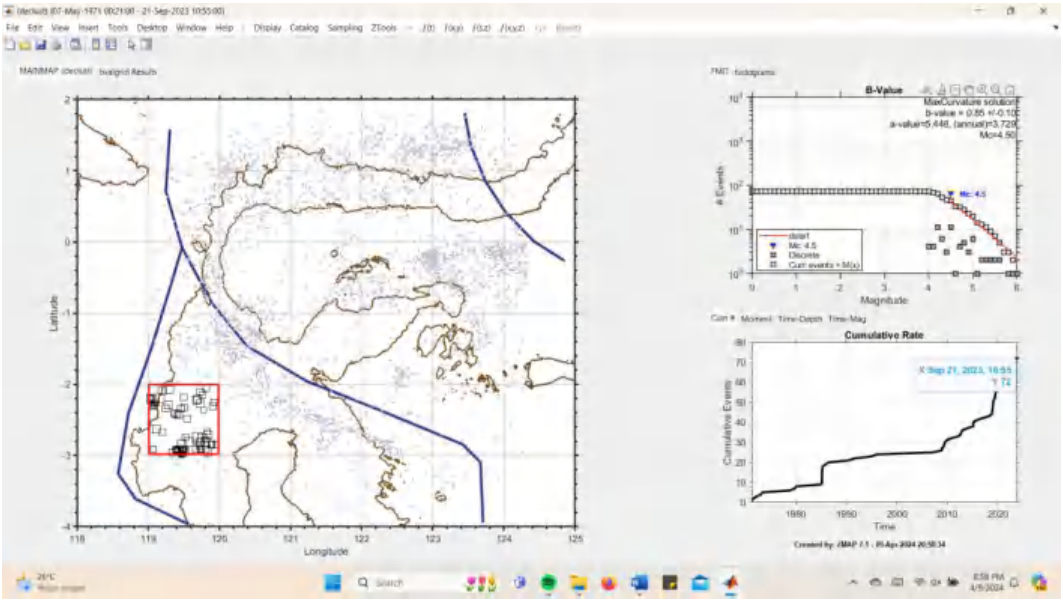

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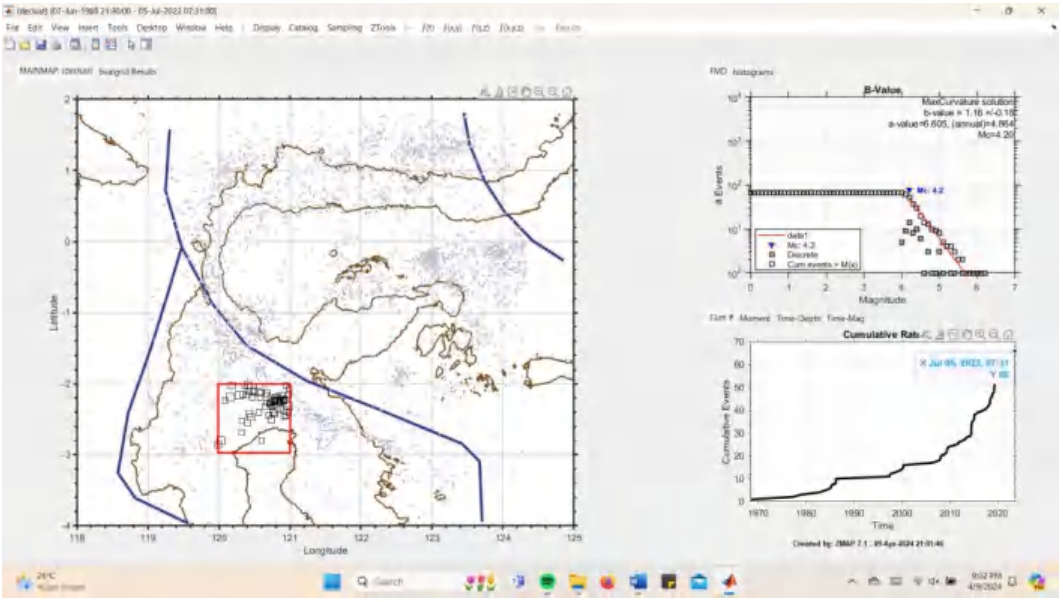

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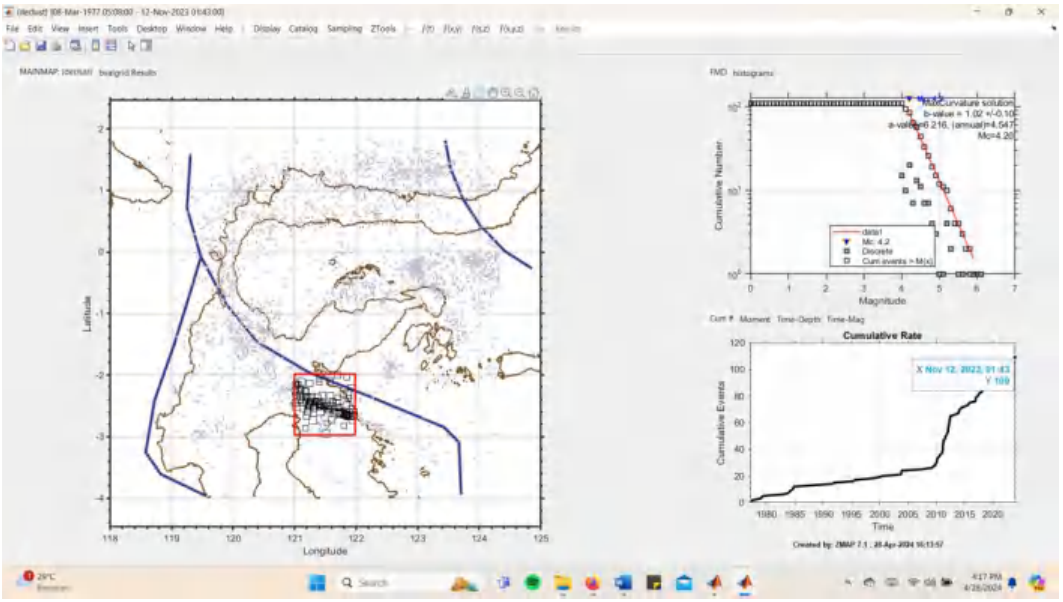

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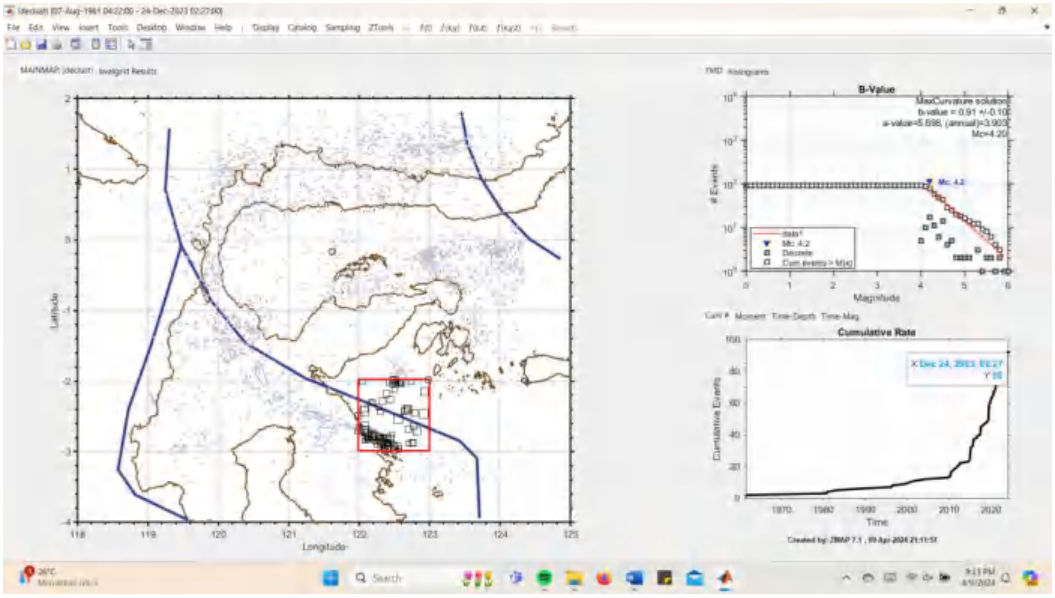

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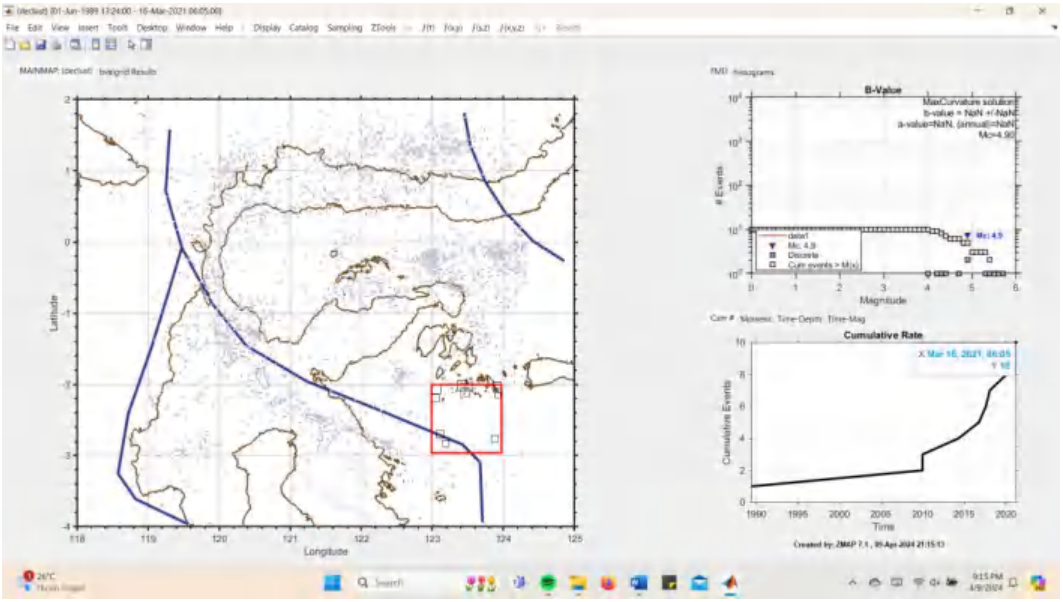

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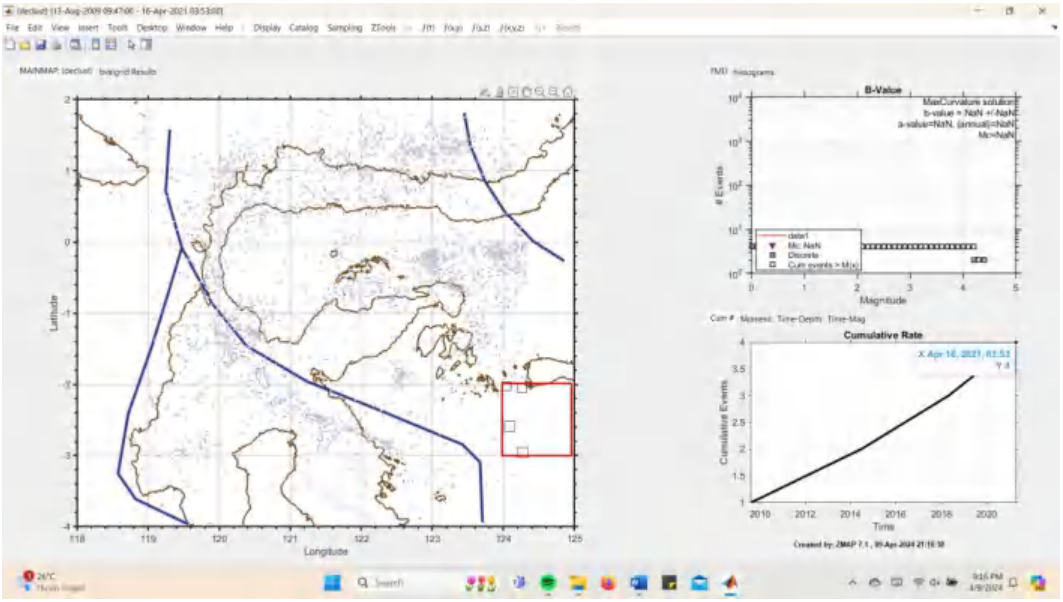

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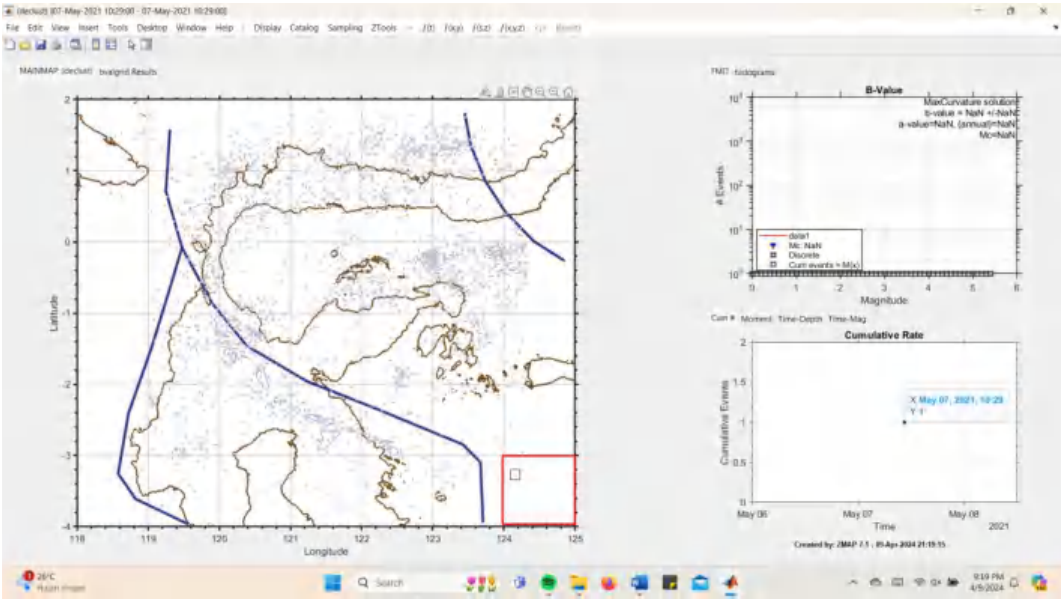

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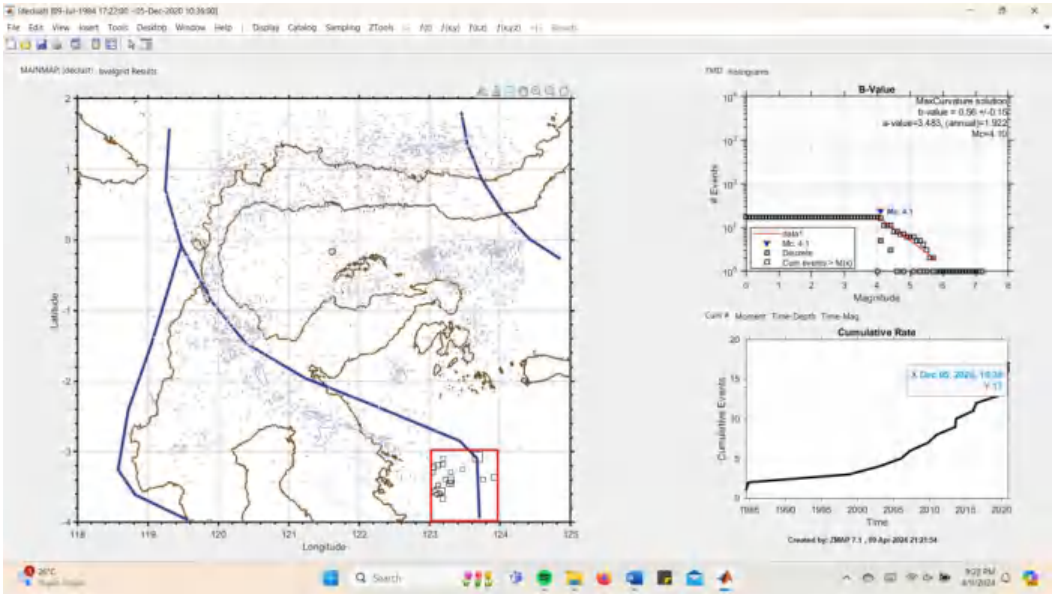

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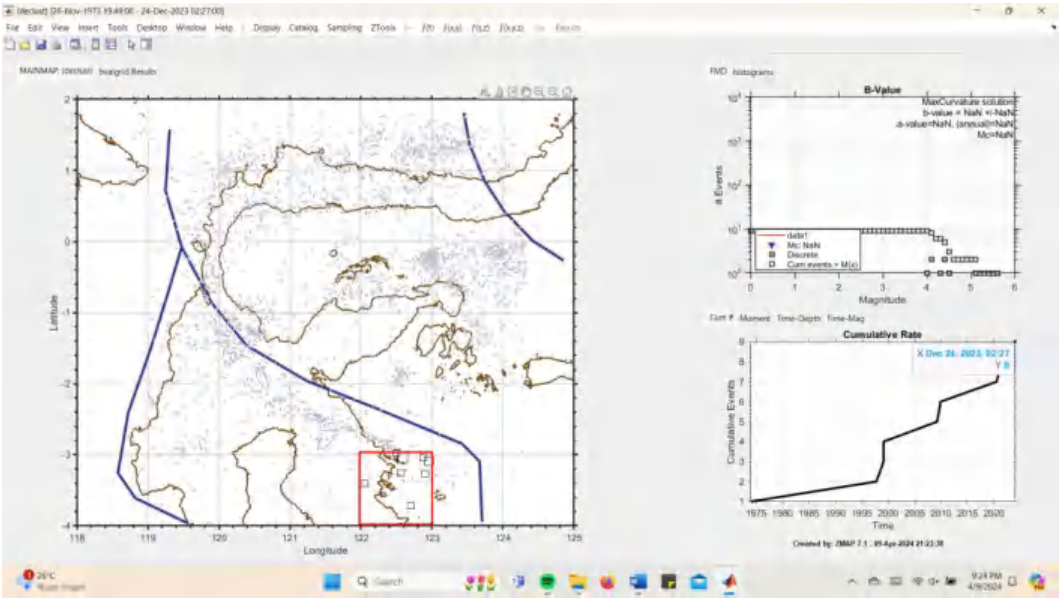

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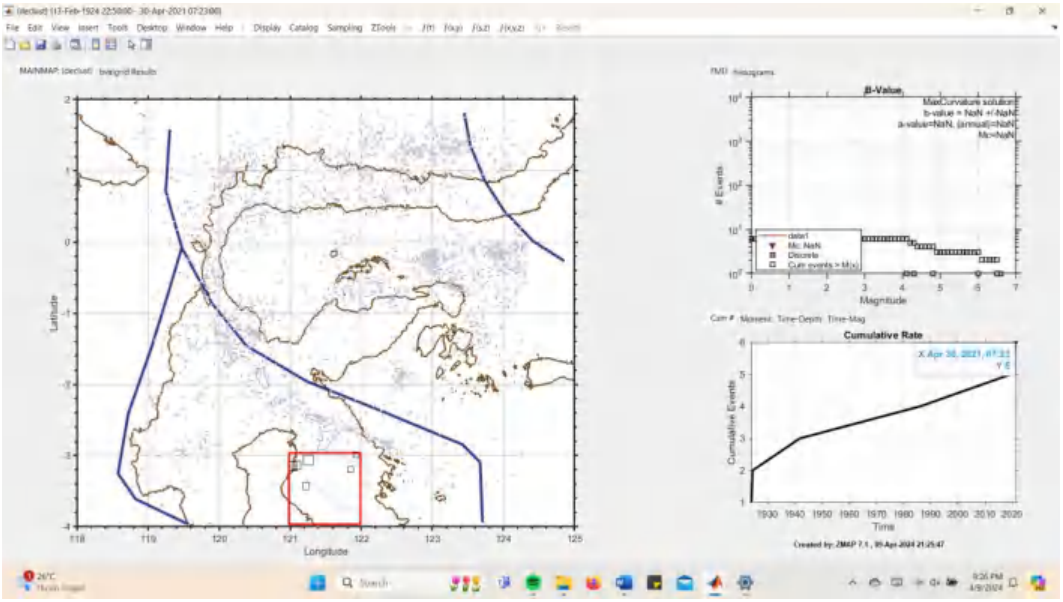

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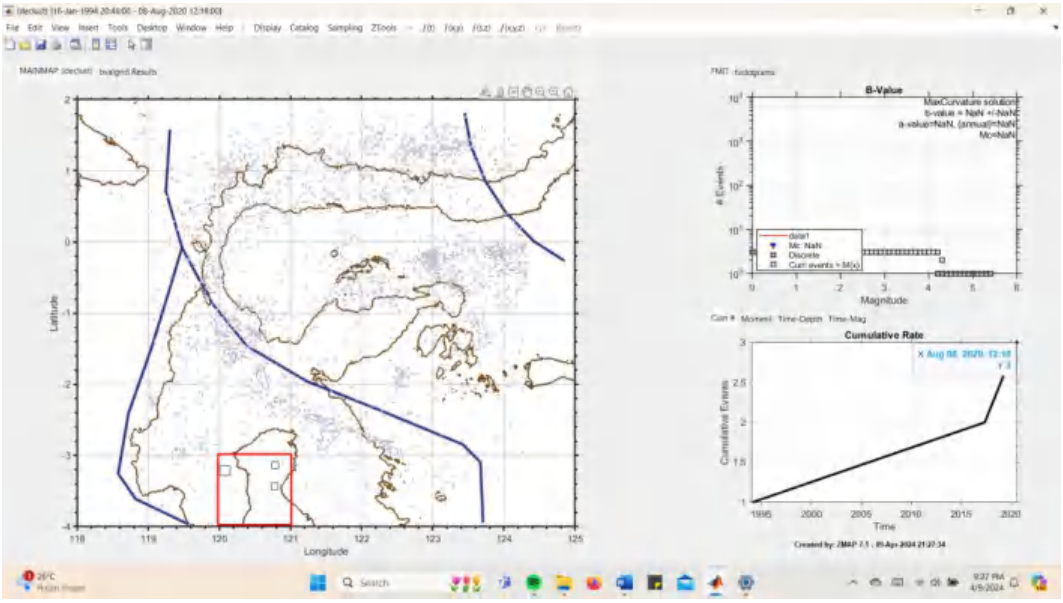

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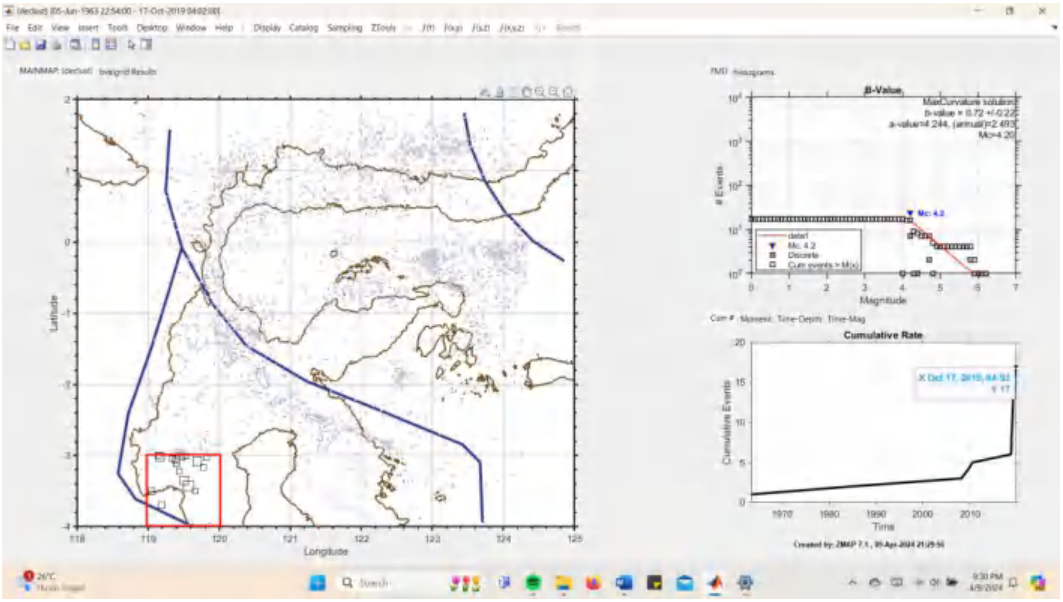
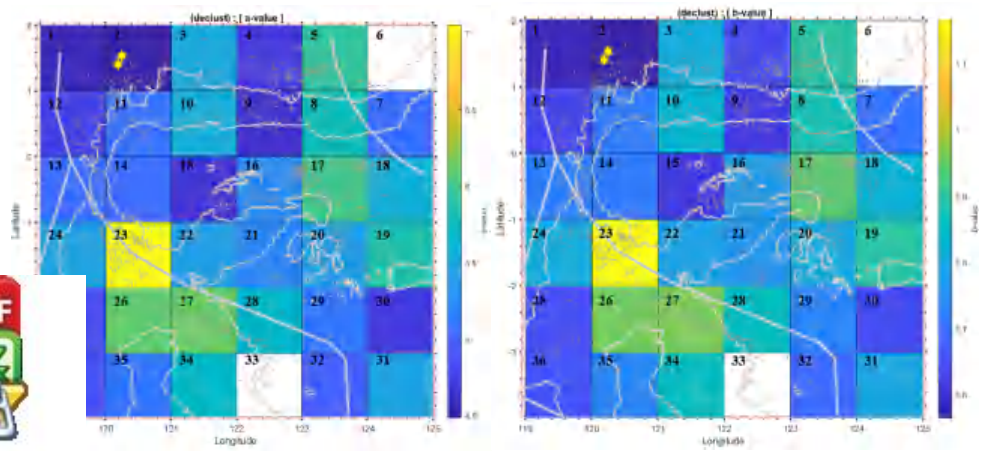


Lampiran 9. Perbandingan 4 *grid* dan 36 *grid*

- Nilai *a-value* dan *b-value* pada 4 Wilayah (4 *grid*)

Wilayah	a-value	b-value
I	5.785	0.7
II	6.365	0.84
III	5.765	0.81
IV	6.574	0.93

- Rata-rata *a-value* dan *b-value* 9 daerah yang mewakili masing-masing 1 grid pada pembagian 4 wilayah



Wilayah	Daerah	Rata-rata *a-value*	Rata-rata *b-value*
I	1-3 & 10-15	4.892222222	0.734444444
II	4-9 & 16-18	5.28175	0.7875
II	19-21 & 28-33	5.1288	0.856
IV	22-27 & 34-36	5.488142857	0.884285714

Lampiran 10. Algoritma untuk memperoleh *a-value* dan *b-value*

Langkah-Langkah Penurunan Rumus *Maximum Likelihood Estimation* (MLE) untuk `*b-value*`

1. Model Gutenberg-Richter

Distribusi frekuensi-magnitudo gempa umumnya mengikuti hukum Gutenberg-Richter:

$$log_{10}(N) = a - bM$$

di mana:

- N adalah jumlah kejadian gempa dengan magnitudo lebih besar atau sama dengan M.
- *a* dan *b* adalah parameter yang akan diestimasikan.

2. Distribusi Eksponensial

Dapat diasumsikan bahwa magnitudo gempa mengikuti distribusi eksponensial, yang dapat dinyatakan sebagai:

$$f(M) = b \ln(10) \cdot 10^{-b(M-M_{min})}$$

di mana M_{min} adalah magnitudo minimum.

3. Fungsi Likelihood

kumpulan data magnitudo gempa M_1, M_2,…., M_N, fungsi likelihood L

ameter *b* adalah produk dari distribusi probabilitas individu:

$$L(b) = \prod_{i=1}^{N} b \cdot \ln(10) \cdot 10^{-b(M_i - M_{min})}$$

4. Log-Likelihood

Lebih mudah bekerja dengan logaritma dari fungsi likelihood (log-likelihood):

$$\ln(L(b)) = \sum_{i=1}^{N} \ln(b \cdot \ln(10) \cdot 10^{-b(M_i - M_{min})})$$

$$\ln(L(b)) = \sum_{i=1}^{N} [\ln(b \cdot \ln(10) \cdot 10^{-b(M_i - M_{min})})]$$

$$\ln(L(b)) = N \cdot \ln(b) + N \cdot ln(\ln(10)) - b \cdot \ln(10) \sum_{i=1}^{N} (M_i - M_{min})$$

5. Maksimumkan Log-Likelihood

Untuk menemukan nilai *b* yang memaksimalkan log-likelihood, kita ambil turunan pertama dari $\ln(L(b))$ terhadap *b* dan setarakan dengan nol:

$$\frac{d}{db} \ln(L(b)) = 0$$

Turunan dari log-likelihood adalah:

$$\frac{d}{db} \ln(L(b)) = \frac{N}{b} - \ln(10) \sum_{i=1}^{N} (M_i - M_{min})$$

Setarakan dengan nol:

$$\frac{N}{b} = \ln(10) \sum_{i=1}^{N} (M_i - M_{min})$$

6. Pecahkan untuk *b*

$$b = \frac{N}{\ln(10) \sum_{i=1}^{N} (M_i - M_{min})}$$

enyederhanakan notasi, digunakan logaritma natural:

$$b = \frac{log_{10}(e)}{(M - M_{min})}$$

di mana $\bar{M}$ adalah magnitudo rata-rata:

$$\bar{M} = \frac{1}{N}\sum_{i=1}^{N} M_i$$

Sehingga:

$$b = \frac{log_{10}(e)}{(M - M_{min})}$$

Dengan:

$$log_{10}(e) \approx 0{,}4343$$

7. Implementasi Rumus di MATLAB

Berikut adalah kode MATLAB yang menggunakan rumus MLE untuk menghitung `*b-value*`:

```
% Baca file data gempa
data = readtable('seismic_data.csv');
% Asumsikan kolom pertama adalah magnitudo gempa
magnitudes = data{:, 1};
% Tentukan magnitudo minimum yang dipertimbangkan (M_min)
M_min = min(magnitudes);
% Hitung magnitudo rata-rata (M_bar)
M_bar = mean(magnitudes);
% Hitung b-value menggunakan metode Maximum Likelihood
b_value = log10(exp(1)) / (M_bar - M_min);
% Hitung nilai a (nilai a adalah log10 jumlah kejadian pada
    ıo M_min)
    ɣth(magnitudes);
     = log10(N) + b_value * M_min;
    ılkan hasil
```

```
fprintf('Nilai a: %.2f\n', a_value);
fprintf('Nilai b: %.2f\n', b_value);
```

Penjelasan

- Magnitudo Minimum (M_{min}): Magnitudo gempa terkecil dalam dataset.
- Magnitudo Rata-rata ($\bar{M}$): Rata-rata magnitudo dari semua kejadian gempa dalam dataset.
- *b-value*: Dihitung menggunakan rumus MLE.
- *a-value*: Dihitung berdasarkan jumlah kejadian gempa dan nilai *b-value*.

Dengan menggunakan penurunan rumus MLE ini, kita dapat menghitung *b-value* secara lebih akurat dan memastikan bahwa analisis seismik yang dilakukan berdasarkan data gempa lebih representatif.