

Report on Microearthquake Survey in Idukki District of Kerala

Introduction:

Small earthquakes were reported to be felt locally in Nedumkandam block in the Idukki district of Kerala with a rumbling sound from 27th February 2020. These earthquakes created panic among the local public. However, there was no loss of life or damage to the property due to these events. National Centre for Seismology (NCS) maintains a countrywide network of 115 seismological observatories, out of which two observatories namely Trivandrum and Kodaikanal are located close to the affected region. Another Observatory at Peechi is also in operation in Kerala.

A team of two scientists from the National Centre for seismology (NCS) visited the affected area in the third week of March 2020 and installed three additional digital portable seismographs during 23 to 25 March 2020 (Details of station location are given in Table 1). Kerala State Disaster Management Authority (KSDMA) extended help and logistic support for setting up the stations and monitoring the activity.

Table-1. Details of temporary field stations

S.No.	Name of the Field Observatory	Latitude (in deg. N)	Longitude (in deg. E)	Date of Installation	Type of equipment
1.	Idukki dam site	09.844	76.978	25-03-2020	Broadband sensor, Accelerometer with 6 channel Digitizer.
2.	Aladi	09.700	77.031	24-03-2020	Broadband sensor with 3-channel digitizer.
3.	Chottupara	09.815	77.216	23-03-2020	-do-

Past Seismicity and tectonics of the region:

The Idukki Dam built on the Periyar River is one of the highest arch dams in Asia (169 m), which has a pre-impoundment record of the background seismicity. Although no significant earthquakes occurred in the immediate vicinity of the reservoir, five earthquakes in the magnitude range 4.1

to 5.0 occurred in Kerala during 1988–2001 (**Figure-1**). The past earthquakes (M:4.0 and above) occurred in the region within a 150km radius of Idukki Dam is enclosed as **Annexure-I**.

The region has witnessed earthquake sequences of slight to moderate magnitudes on three occasions namely, 1988, 1996, and 2000–2001. An earthquake of magnitude M:5.0 was occurred 12th December 2000 in the border regions of Idukki and Kottayam districts of Kerala. This earthquake was widely felt in Kerala and adjoining parts of Tamil Nadu.

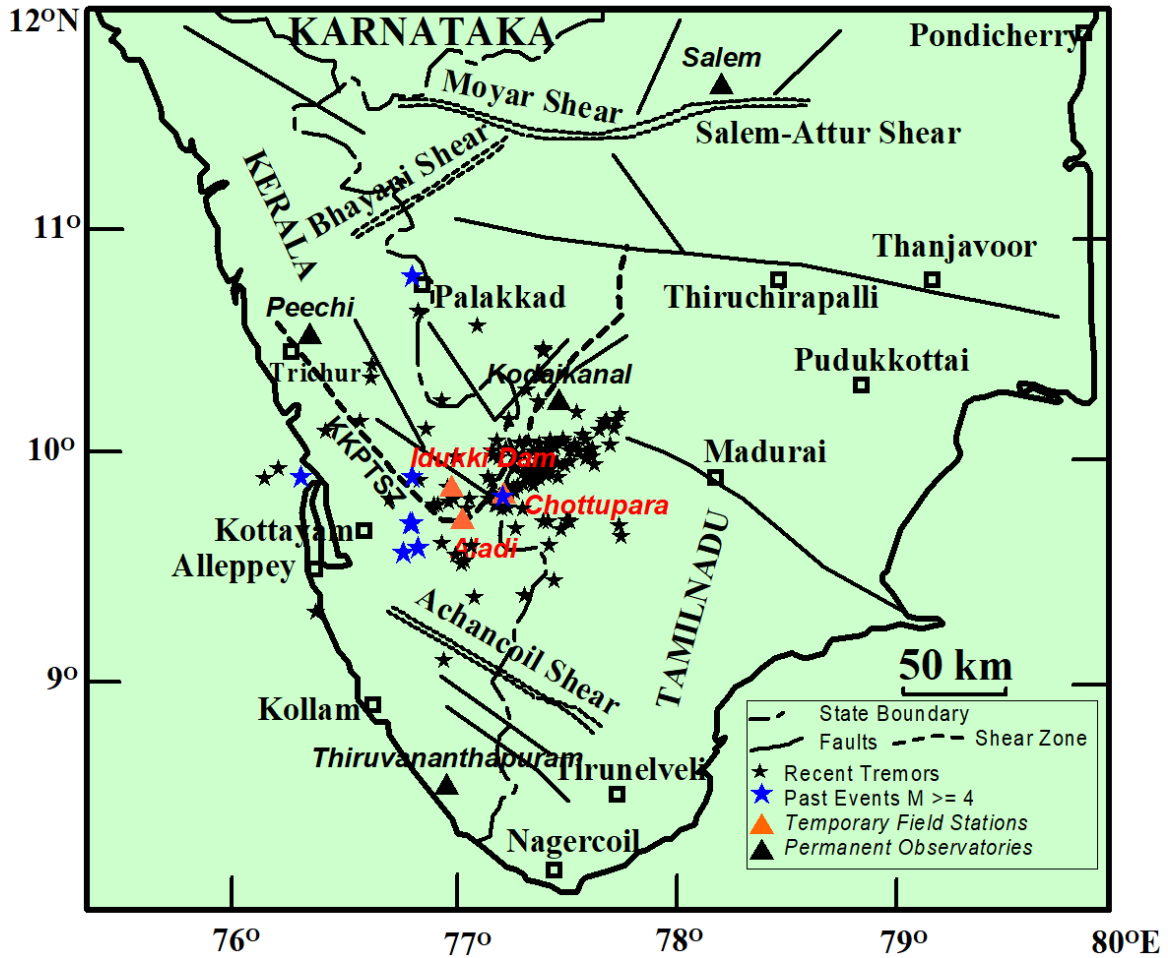


Figure 1: Tectonic map of the Idukki dam area (modified after GSI, 2000) with the locations of historical earthquakes since year 1900 (M:4.0 and above). The map also depicts the location of current earthquake activity from 12.03.2020 to 07.09.2020. KKPTSZ stands for Karur–Kambam–Painavu–Trichur Shear Zone.

Micro-Earthquake Survey:

The broadband seismometer installed by the touring party at the Idukki dam developed a technical problem on 04.04.2020 and became defunct. This equipment was replaced with the one installed at Aladi on April 7, 2020, as Aladi was found to be a bit far from the source. Unfortunately, the field equipment installed at Idukki got damaged on 20.05.2020, due to heavy thunderstorms and lightning occurred in the area, and at present only one field station at Chottupara is working. Data from the temporary and permanent station at Kodaikanal (KOD) are used for the analysis, the activity is still being continuously monitored. The analysis shows that a total of 137 events of magnitude ≥ 0.4 were recorded during the period from 12.03.2020 to 07.09.2020. The activity is concentrated along NE-SW direction (**Figure-1**). The list of tremors is given in **Annexure-II**.

The analysis further shows that the earthquake activity was maximum in May 2020 with the occurrence of a total of 69 earthquakes in the magnitude range M 0.4-2.6. Also, most of the earthquake events recorded during the reported period i.e. 12-03-2020 to 07-09-2020 are falling in the magnitude range 1.0 to 1.9. **Figure-2**. Shows the magnitude-wise distribution of earthquakes.

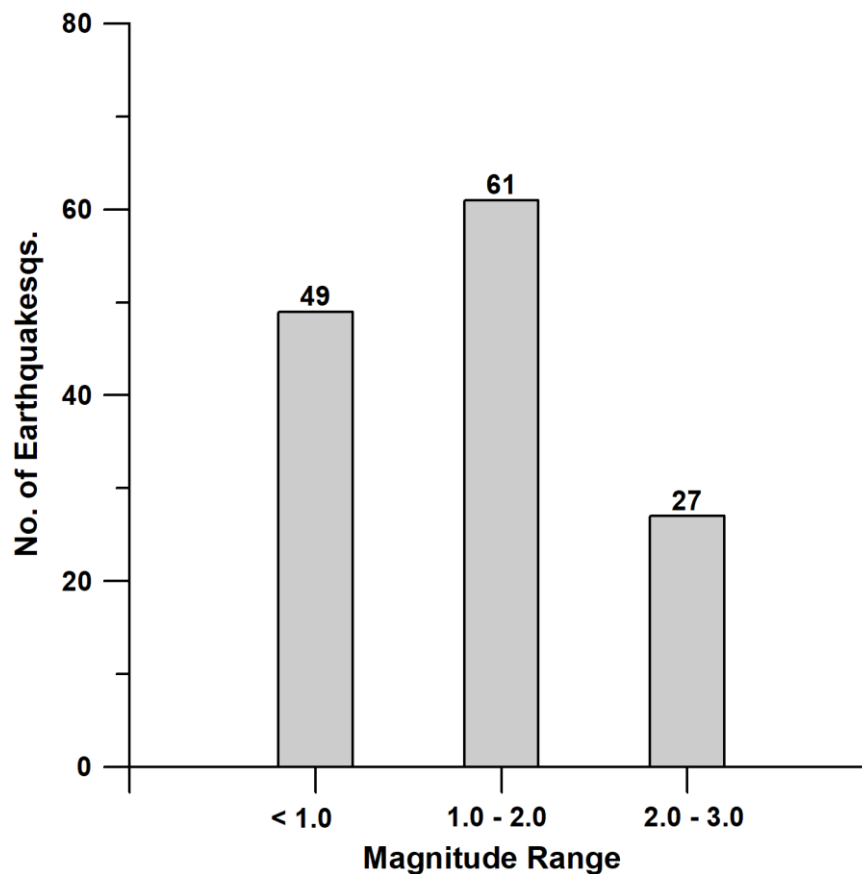


Figure 2: Magnitude wise distribution of earthquakes from 12-03-2020 to 07.09.2020.

Four earthquakes with maximum magnitude (M:2.6) occurred on 19th May 2020 at about 58 km ESE; 03rd August 2020 at about 89km SW; and at two on 10th August 2020 at about 87km and 92km ENE of Idukki dam seismological observatory. The daily frequency of tremors is given in **Figure-3**. It is also, observed that maximum events have occurred in hypocentral distance between 20 and 60 km from the seismological observatory at the Idukki dam. Further, the sequence of earthquakes is found to be the shallow focus, hence sound was heard by the local public.

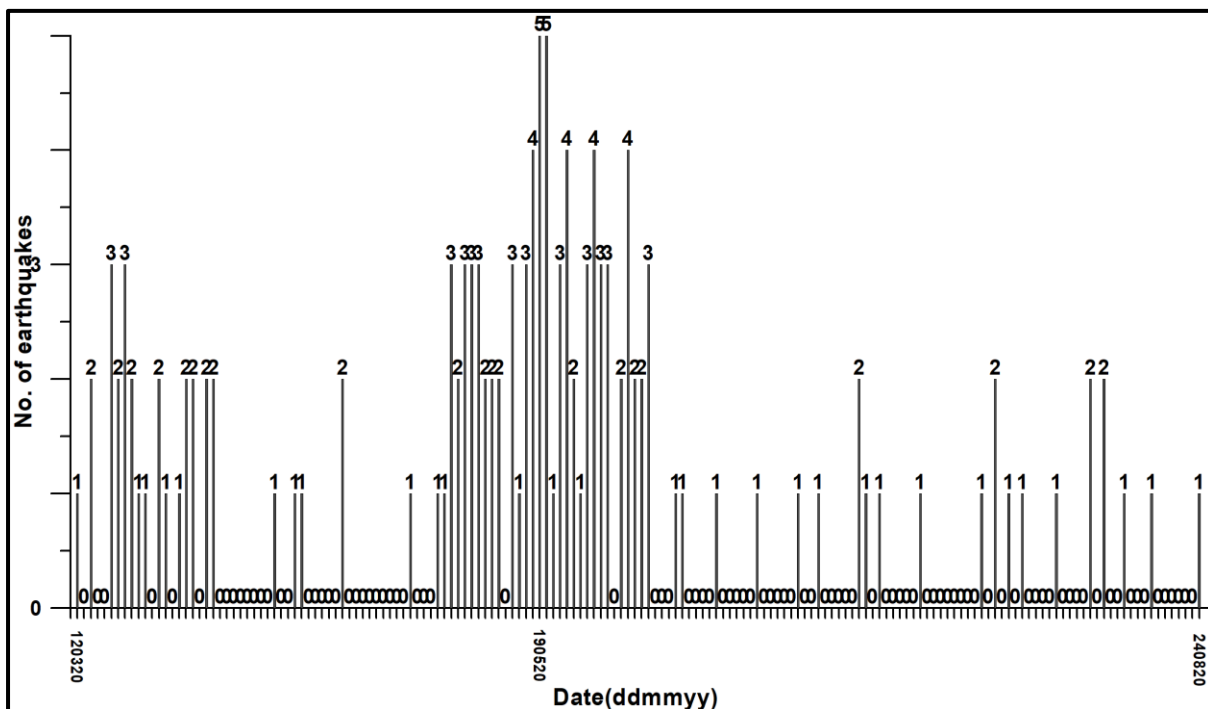


Figure 3: Daily frequency of earthquakes (from 12.03.2020 to 07.09.2020). No earthquake was recorded after 24.08.2020.

Conclusion:

The present earthquake activity is found to be mainly associated with NW-SE trending Periyar fault and Karur–Kambam–Painavu–Trichur Shear Zone (KKPTSZ), with a maximum magnitude of M:2.6. Such a low-intensity earthquake can't generate high ground motion to damage to buildings/ structures. Moreover, the area falls under seismic zone III [IS 1893(Part-1) -2016], where the maximum expected MM scale intensity is VII.

Annexure-1

List of the past earthquakes occurred within 150km radius of idukki dam for the period January 1900 to sept. 2019 (source: NCS catalogue)

DATE (yyyy.mm.day)			Origin- time Hr Min Sec (in UTC)	Lat- itude (deg.N)	Long- itude (deg. E)	Depth (km)	Mag.	Distance (km) and direction from Idukki Arch Dam
1900	02	08	-- -- --	10.8	76.8	-	5.5	108, N
1953	02	25	-- -- --	09.58	76.83	-	4.8	33, SSW
1953	03	21	-- -- --	09.56	76.76	-	4.8	39, SW
1953	07	26	-- -- --	09.9	76.3	-	4.5	74, W
1953	07	26	-- -- --	09.9	76.3	-	5.0	74, W
1988	06	07	03:07:00.0	09.81	77.21	50	4.5	26, E
1988	06	07	15:26:00.0	09.81	77.21	50	4.2	26, E
1996	03	19	16:32:40.2	09.9	76.8	33	4.1	20, WNW
2000	12	12	01:23:59.2	09.69	76.79	14	5.0	27, SW
2001	01	07	02:56: 00.2	09.69	76.8	16	4.9	26, SW

Annexure-II

List of tremors recorded from 12.03.2020 to 07.09.2020

S.No.	Date(dd-mm-yy)	Origin Time (IST)	Lat. (deg.N)	Long. (deg.E)	Magnitude (M_c / M_L)	Epicentral dist. (km) from Idukki dam
1	12-03-2020	11:45:50	10.05	77.385	0.7	50
2	14-03-2020	12:00:03	10.244	76.942	1.9	47
3	14-03-2020	19:44:04	9.709	77.522	1.8	61
4	17-03-2020	08:45:31	9.958	77.631	1.4	73
5	17-03-2020	13:44:07	9.972	77.523	1.0	61
6	17-03-2020	18:57:56	10.034	77.456	1.3	56
7	18-03-2020	10:57:09	10.024	77.414	1.8	52
8	18-03-2020	14:44:05	10.09	77.578	1.4	71
9	19-03-2020	11:22:15	9.902	77.468	1.9	54
10	19-03-2020	19:37:02	10.07	77.433	1.9	56
11	19-03-2020	22:00:48	10.351	77.39	0.7	72
12	20-03-2020	06:16:30	10.072	77.488	1.4	61
13	20-03-2020	04:18:48	10.159	77.246	1.8	46
14	21-03-2020	04:36:59	10.049	77.452	1.8	57
15	22-03-2020	20:00:01	9.929	77.416	1.1	49
16	24-03-2020	16:57:38	9.763	77.213	0.4	27
17	24-03-2020	18:33:45	9.558	77.007	0.4	32
18	25-03-2020	22:13:00	9.806	77.067	0.5	11
19	27-03-2020	06:08:49	9.614	76.944	0.4	26
20	28-03-2020	12:28:38	9.81	76.997	0.5	4
21	28-03-2020	23:17:43	9.807	77.155	0.8	20
22	29-03-2020	04:54:25	9.707	77.033	1.5	16
23	29-03-2020	21:18:05	9.095	76.953	1.2	83
24	31-03-2020	06:38:37	9.38	77.317	0.9	64
25	31-03-2020	17:10:12	10.342	76.623	1.4	68
26	01-04-2020	09:51:15	10.152	76.574	1.7	56
27	01-04-2020	11:06:01	10.106	76.416	1.6	68
28	10-04-2020	07:18:06	9.71	77.399	0.7	48
29	13-04-2020	16:43:41	10.016	77.357	0.9	46
30	14-04-2020	15:34:45	9.954	77.399	0.9	48
31	20-04-2020	16:23:17	9.989	77.2	0.6	29
32	20-04-2020	16:38:06	9.914	77.413	0.8	48
33	30-04-2020	17:34:45	10.466	77.403	1.3	83
34	04-05-2020	06:14:57	9.855	77.268	0.9	32
35	05-05-2020	09:07:57	9.793	76.976	0.7	6
36	06-05-2020	13:38:16	9.927	77.362	0.8	43

S.No.	Date(dd-mm-yy)	Origin Time (IST)	Lat. (deg.N)	Long. (deg.E)	Magnitude (M _c /M _L)	Epicentral dist. (km) from Idukki dam
37	06-05-2020	15:08:54	9.888	77.35	0.8	41
38	06-05-2020	19:26:24	9.945	77.383	0.9	46
39	07-05-2020	08:15:08	9.941	77.386	1.0	46
40	07-05-2020	15:39:40	9.936	77.363	0.7	43
41	08-05-2020	06:49:51	9.92	77.426	0.7	50
42	08-05-2020	14:42:30	9.912	77.366	0.7	43
43	08-05-2020	01:23:08	9.81	76.706	1.0	30
44	09-05-2020	10:48:46	9.925	77.354	0.8	42
45	09-05-2020	13:24:58	9.867	77.356	0.9	42
46	09-05-2020	20:12:08	9.771	77.242	1.1	30
47	10-05-2020	13:34:26	9.919	77.328	1.3	39
48	10-05-2020	18:54:03	9.925	77.31	0.7	37
49	10-05-2020	23:53:09	10.117	76.873	2.3	32
50	11-05-2020	16:51:39	9.765	77.307	1.3	37
51	11-05-2020	22:04:03	10.001	77.176	1.0	28
52	12-05-2020	14:15:09	9.678	77.276	1.8	38
53	12-05-2020	15:02:10	9.849	77.258	1.1	31
54	13-05-2020	06:39:41	9.84	77.273	0.5	32
55	13-05-2020	07:56:00	10.067	77.592	1.3	72
56	15-05-2020	09:17:33	9.994	77.005	0.8	17
57	15-05-2020	11:03:23	9.782	76.927	0.4	9
58	15-05-2020	19:51:34	9.859	76.968	0.4	2
59	16-05-2020	20:54:01	9.84	77.238	0.9	29
60	17-05-2020	06:44:18	10.144	77.676	2.1	83
61	17-05-2020	14:21:24	9.843	77.245	1.0	29
62	17-05-2020	23:16:47	9.816	77.22	1.4	27
63	18-05-2020	13:07:51	10.471	77.399	1.7	83
64	18-05-2020	15:28:13	10.191	77.554	1.3	74
65	18-05-2020	17:39:25	9.849	77.247	0.6	30
66	18-05-2020	19:11:23	9.598	77.076	0.9	29
67	19-05-2020	05:59:54	9.521	77.032	1.6	36
68	19-05-2020	06:44:35	10.237	77.38	1.3	62
69	19-05-2020	13:26:07	9.533	77.047	1.8	35
70	19-05-2020	14:15:02	9.841	77.243	1.5	29
71	19-05-2020	03:01:23	9.675	77.479	2.6	58
72	20-05-2020	05:35:53	9.947	77.329	0.9	40
73	20-05-2020	09:03:59	9.763	77.052	1.0	12
74	20-05-2020	14:32:20	9.828	77.177	1.9	22
75	20-05-2020	16:36:39	10.02	77.611	1.8	72

S.No.	Date(dd-mm-yy)	Origin Time (IST)	Lat. (deg.N)	Long. (deg.E)	Magnitude (M _c /M _L)	Epicentral dist. (km) from Idukki dam
76	20-05-2020	18:39:28	9.938	77.369	1.1	44
77	21-05-2020	11:38:49	10.019	77.169	1.1	29
78	22-05-2020	09:44:50	9.899	77.385	0.9	45
79	22-05-2020	13:51:02	9.966	77.464	1.3	55
80	22-05-2020	16:31:34	9.931	77.363	1.2	43
81	23-05-2020	00:02:00	9.987	77.433	1.2	52
82	23-05-2020	05:54:54	10.054	77.293	1.2	42
83	23-05-2020	14:15:21	9.982	77.428	1.2	52
84	23-05-2020	19:01:23	9.979	77.387	1.0	47
85	24-05-2020	06:19:43	9.977	77.418	1.1	51
86	24-05-2020	10:17:43	10.022	77.519	1.2	63
87	25-05-2020	14:34:03	10.064	77.193	0.9	34
88	26-05-2020	16:01:06	9.947	77.375	1.0	45
89	26-05-2020	19:55:32	10.06	77.335	1.2	46
90	26-05-2020	21:44:29	10.024	77.413	0.8	52
91	27-05-2020	10:24:12	9.931	77.37	0.9	44
92	27-05-2020	11:56:08	9.935	77.402	1.2	48
93	27-05-2020	17:26:56	10.059	77.489	1.9	61
94	27-05-2020	23:25:18	10.291	77.327	0.7	63
95	28-05-2020	11:54:19	9.936	77.342	1.1	41
96	28-05-2020	14:19:54	9.925	77.346	0.8	41
97	28-05-2020	15:17:55	9.836	77.247	0.8	30
98	29-05-2020	14:57:58	9.942	77.27	0.7	34
99	29-05-2020	16:32:53	9.903	77.151	0.4	20
100	29-05-2020	18:46:57	10.574	77.102	2.3	82
101	31-05-2020	02:26:42	10.4	76.625	2.0	73
102	31-05-2020	17:08:58	9.941	76.204	2.3	86
103	01-06-2020	13:18:42	9.995	77.618	1.9	72
104	01-06-2020	14:02:33	10.155	77.684	1.8	85
105	01-06-2020	18:58:43	9.373	77.091	2.3	54
106	01-06-2020	19:09:46	9.866	77.285	0.4	34
107	02-06-2020	13:11:08	9.984	77.592	1.9	69
108	02-06-2020	20:40:48	9.605	77.428	0.8	56
109	03-06-2020	13:23:48	9.887	77.17	0.4	22
110	03-06-2020	17:12:14	9.991	77.283	0.8	37
111	04-06-2020	17:22:46	9.846	77.246	0.4	29
112	04-06-2020	17:31:08	9.784	77.185	0.5	24
113	04-06-2020	18:00:02	9.78	77.19	0.4	24
114	08-06-2020	13:13:01	10.03	77.232	2.0	35

S.No.	Date(dd-mm-yy)	Origin Time (IST)	Lat. (deg.N)	Long. (deg.E)	Magnitude (M _c /M _L)	Epicentral dist. (km) from Idukki dam
115	09-06-2020	13:12:22	10.002	77.307	2.3	40
116	14-06-2020	01:01:29	9.707	77.421	1.9	51
117	20-06-2020	14:47:23	10.018	77.562	2.4	67
118	26-06-2020	18:12:12	10.048	77.703	2.0	83
119	29-06-2020	13:16:37	9.693	77.742	2.3	85
120	05-07-2020	17:25:44	10.008	77.404	2.3	50
121	05-07-2020	17:46:06	10.112	77.655	2.0	80
122	06-07-2020	15:35:16	9.889	76.841	2.2	16
123	08-07-2020	13:37:51	9.714	77.507	2.4	60
124	14-07-2020	13:18:11	10.029	77.622	1.7	73
125	23-07-2020	12:16:03	10.046	77.544	1.8	66
126	25-07-2020	18:28:20	10.156	77.729	2.3	89
127	25-07-2020	21:13:59	10.459	77.402	2.3	83
128	27-07-2020	13:20:23	9.957	77.497	2.1	58
129	29-07-2020	07:00:34	9.644	77.754	2.0	88
130	03-08-2020	17:59:08	9.31	76.374	2.6	89
131	08-08-2020	08:48:33	10.64	76.838	2.2	90
132	08-08-2020	18:34:27	9.78	76.907	2.3	11
133	10-08-2020	13:10:39	10.181	77.746	2.6	92
134	10-08-2020	23:36:34	10.121	77.723	2.6	87
135	13-08-2020	14:06:07	9.872	77.314	1.3	37
136	17-08-2020	18:40:22	9.901	76.144	2.2	92
137	24-08-2020	08:01:07	9.448	77.452	2.1	68

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