

Supplementary Materials

Stalagmite-inferred climate in the western Mediterranean during the Roman Warm Period

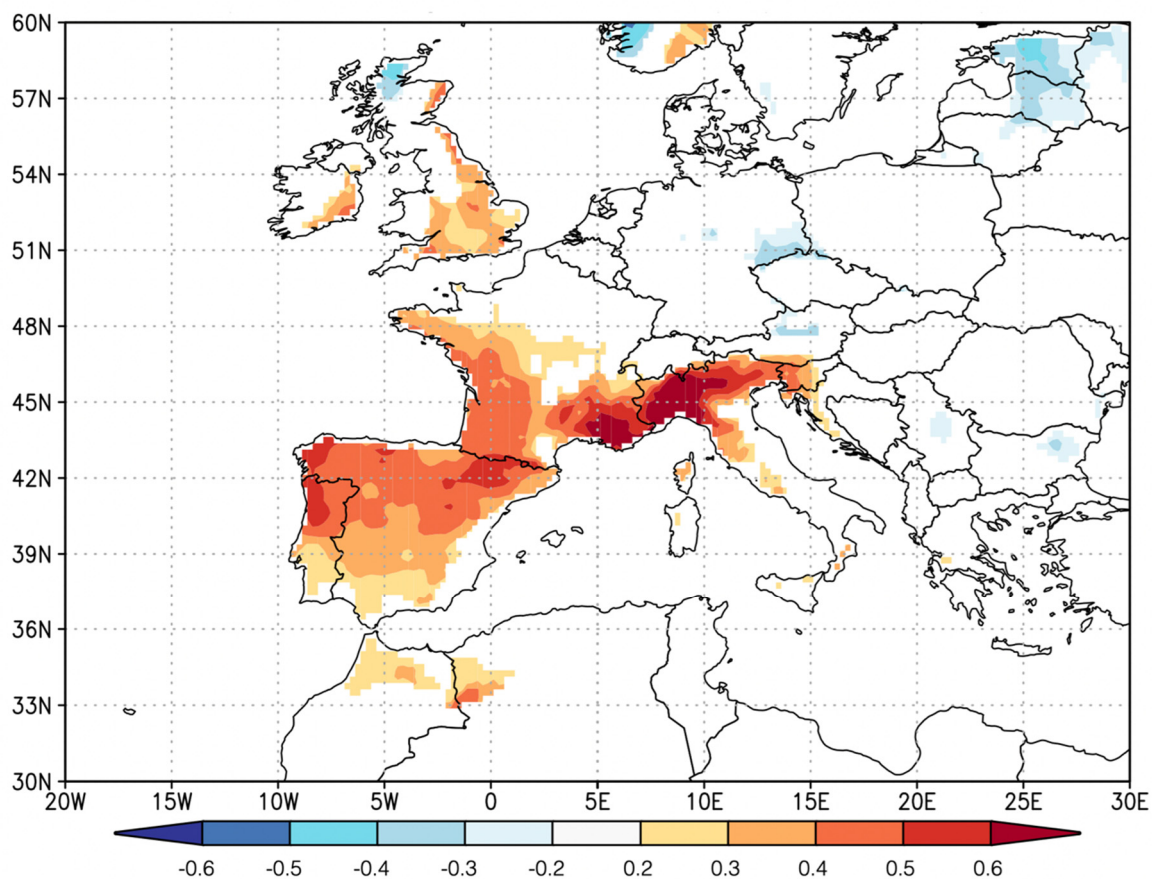


Figure S1. Correlation map. Correlation analysis between Genoa precipitation data and regional precipitation patterns during rainy seasons (September–February) in 1950–2008 A.D. (Data from E-OBS 25.0e, [53]). Color-shades indicate the correlation coefficients ($p < 0.1$).

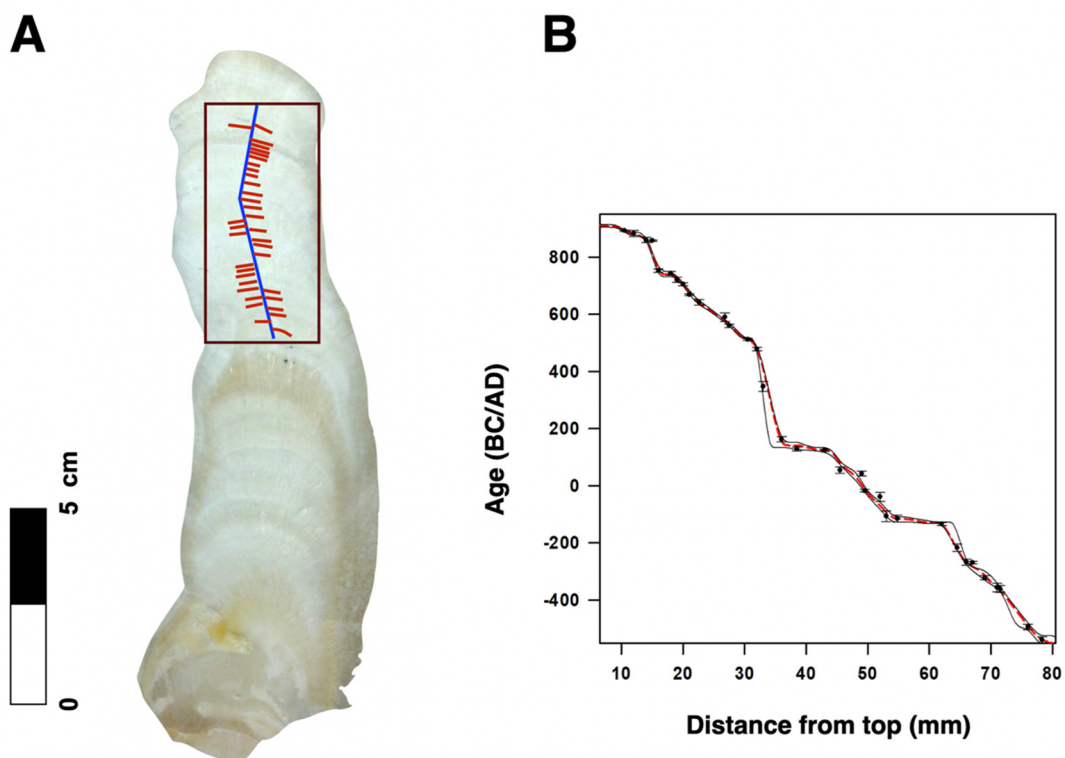


Figure S2. Photograph of stalagmite BA14-1 and age model. **(A)** Photograph of stalagmite BA14-1. The brown rectangle marks the section used in this study (6.5-80.5 mm from the top). The blue and red lines indicate the position for isotope analysis, U-Th dates. **(B)** StalAge-based age model [32] of BA14-1 during 6.5-80.5 mm from the top. The red line indicates the mean age and black lines denote 2-sigma age limits.

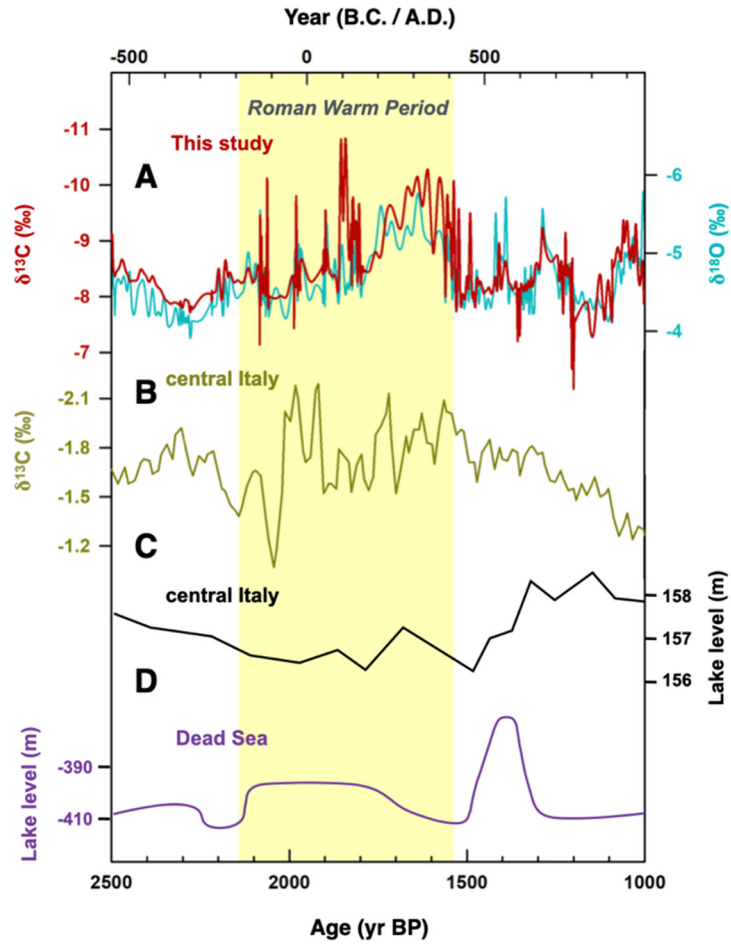


Figure S3. Comparison among Mediterranean proxy records. (A) Bāsura $\delta^{13}\text{C}$ (red) and $\delta^{18}\text{O}$ (tiffany blue). (B) $\delta^{13}\text{C}$ records from Corchia cave, central Italy [18]. (C) composite lake level records from central Italy [16]. (D) Dead Sea level [17]. The yellow bar denotes the Roman Warm Period.

Table S1. Data of stable isotopes of BA14-1.

Depth	Age (yr BP)	Error (2s)	$\delta^{13}\text{C}$	$\delta^{18}\text{O}$
6.50	997.05	6.88	-8.474	-4.588
6.57	1001.68	6.83	-7.874	-5.594
6.64	1006.30	6.78	-8.641	-5.648
6.71	1010.92	6.72	-8.306	-4.836
6.79	1015.55	6.66	-8.252	-4.933
6.86	1020.17	6.59	-8.658	-4.918
6.93	1024.79	6.52	-9.301	-5.135
7.00	1029.42	6.45	-8.617	-4.881
7.25	1034.04	6.16	-8.908	-5.206
7.50	1038.66	5.83	-8.735	-4.855
7.75	1043.29	5.48	-8.729	-4.865
8.00	1047.91	5.10	-9.288	-5.014
9.00	1052.53	3.60	-9.248	-4.945
9.50	1057.16	2.98	-8.976	-5.000
11.00	1059.78	4.38	-9.368	-4.730
11.33	1062.41	6.85	-9.031	-4.797
11.67	1065.04	9.07	-8.775	-4.687
12.00	1067.66	10.03	-8.634	-4.636
12.50	1075.25	9.95	-8.884	-4.902
13.00	1082.83	9.71	-8.650	-4.552
14.00	1090.42	8.76	-8.522	-4.350
14.50	1091.21	5.32	-8.554	-4.166
15.00	1092.00	2.19	-7.542	-4.307
15.10	1102.50	2.30	-8.294	-4.124
15.20	1112.99	2.61	-7.578	-4.300
15.30	1123.49	3.06	-8.369	-4.299
15.40	1133.99	3.61	-7.942	-4.434
15.50	1144.49	4.21	-7.303	-4.275
15.60	1154.98	4.81	-7.513	-4.419
15.70	1165.48	5.36	-7.906	-4.273
15.80	1175.98	5.81	-5.929	-4.507
15.90	1186.47	6.12	-5.927	-4.351
16.00	1196.97	6.23	-7.539	-4.469
16.10	1197.48	6.23	-7.526	-4.362
16.20	1197.98	6.23	-7.428	-4.283
16.30	1198.49	6.23	-6.859	-4.520
16.40	1199.00	6.22	-7.621	-4.492
16.50	1199.50	6.22	-6.510	-4.459
16.60	1200.01	6.21	-6.719	-4.419
16.70	1200.52	6.21	-7.935	-4.336
16.80	1201.02	6.20	-5.648	-4.599
16.90	1201.53	6.19	-5.116	-4.552
17.00	1202.03	6.19	-7.140	-4.590
17.10	1202.54	6.18	-6.953	-4.407
17.20	1203.05	6.17	-8.232	-4.281
17.30	1203.55	6.17	-8.472	-4.550
17.40	1204.06	6.16	-6.039	-4.672
17.50	1204.57	6.16	-6.723	-4.546
17.60	1205.07	6.15	-6.059	-4.497
17.70	1205.58	6.15	-7.793	-4.435
17.80	1206.09	6.14	-8.469	-4.631
17.90	1206.59	6.14	-8.436	-4.432
18.00	1207.10	6.14	-7.443	-4.366
18.10	1209.30	6.21	-8.396	-4.626
18.20	1211.49	6.40	-8.329	-4.514
18.30	1213.69	6.68	-8.530	-4.869
18.40	1215.89	7.02	-8.429	-4.594

18.50	1218.08	7.39	-8.559	-4.833
18.60	1220.28	7.76	-8.399	-4.469
18.70	1222.48	8.10	-9.144	-4.673
18.80	1224.68	8.38	-8.402	-4.570
18.90	1226.87	8.57	-8.527	-4.650
19.00	1229.07	8.64	-7.693	-4.569
19.25	1233.05	8.27	-8.566	-4.684
19.50	1237.03	7.37	-8.419	-4.565
19.75	1241.01	6.30	-8.311	-4.420
20.00	1244.98	5.40	-8.732	-4.602
20.33	1263.10	4.38	-8.626	-4.977
20.67	1281.22	3.47	-8.930	-5.196
21.00	1287.91	3.07	-9.216	-5.558
21.50	1294.61	4.29	-8.535	-4.801
22.00	1301.30	6.88	-8.591	-4.811
22.50	1308.00	9.21	-8.530	-4.617
23.00	1310.88	10.45	-8.312	-4.239
23.50	1313.76	11.50	-8.233	-4.312
24.00	1316.65	12.40	-8.193	-4.255
24.25	1319.53	12.80	-8.347	-4.822
24.50	1322.41	13.16	-8.165	-4.560
24.75	1325.30	13.48	-8.244	-4.226
25.00	1328.18	13.77	-8.247	-4.648
25.20	1331.06	13.97	-8.115	-4.456
25.40	1333.95	14.15	-8.148	-4.420
25.60	1336.83	14.30	-8.219	-4.814
25.80	1339.71	14.43	-8.093	-4.367
26.00	1342.60	14.54	-8.181	-4.330
26.09	1345.48	14.58	-8.160	-4.565
26.18	1348.36	14.62	-8.123	-4.385
26.27	1351.25	14.65	-7.299	-4.332
26.36	1354.13	14.67	-8.148	-4.483
26.45	1357.01	14.70	-7.203	-4.309
26.55	1359.90	14.71	-8.135	-4.420
26.64	1365.99	14.72	-8.176	-4.478
26.73	1372.09	14.73	-8.134	-4.521
26.82	1378.18	14.71	-8.206	-4.580
26.91	1384.28	14.16	-8.333	-4.449
27.00	1390.37	13.00	-8.617	-5.702
27.25	1395.14	8.46	-8.550	-5.046
27.50	1399.92	5.62	-8.288	-4.911
27.75	1404.69	5.18	-8.220	-4.951
28.00	1409.46	4.78	-8.959	-4.736
28.33	1414.23	4.31	-8.138	-4.633
28.67	1419.01	3.91	-8.336	-5.512
29.00	1423.78	3.57	-8.220	-4.708
29.33	1428.55	3.30	-8.064	-4.413
29.67	1433.32	3.10	-8.081	-4.299
30.00	1438.10	2.96	-8.167	-4.396
30.50	1442.93	2.89	-8.114	-4.388
31.00	1447.77	3.20	-8.097	-4.287
31.20	1452.60	3.50	-8.058	-4.518
31.40	1457.44	3.91	-8.185	-4.565
31.60	1462.27	4.41	-8.271	-4.611
31.80	1467.11	5.01	-8.215	-4.355
32.00	1471.95	5.72	-8.322	-4.767
32.10	1476.58	6.35	-7.809	-4.585
32.20	1481.22	7.43	-8.079	-4.381
32.30	1485.86	8.82	-8.122	-4.501
32.40	1490.50	10.41	-9.498	-4.707
32.50	1495.14	12.09	-8.226	-4.380
32.60	1499.78	13.72	-8.365	-4.665

32.70	1504.42	15.20	-7.992	-4.394
32.80	1509.06	16.41	-7.984	-4.303
32.90	1513.70	17.22	-8.014	-4.432
33.00	1518.34	17.51	-7.999	-4.400
33.10	1522.98	17.49	-9.569	-4.814
33.20	1527.62	17.42	-8.027	-4.304
33.30	1532.26	17.31	-8.246	-4.762
33.40	1536.90	17.15	-10.072	-4.791
33.50	1541.54	16.96	-8.334	-4.417
33.60	1546.18	16.74	-9.275	-5.164
33.70	1550.81	16.48	-9.238	-4.891
33.80	1555.45	16.20	-9.766	-5.228
33.90	1560.09	15.89	-8.016	-4.375
34.00	1564.73	15.56	-9.238	-4.962
34.10	1579.54	15.21	-10.076	-5.288
34.20	1594.34	14.85	-8.773	-5.127
34.30	1609.15	14.47	-10.259	-5.156
34.40	1623.96	14.08	-9.622	-5.324
34.50	1638.76	13.68	-10.149	-5.766
34.60	1653.57	13.28	-9.809	-5.247
34.70	1668.38	12.88	-9.960	-5.354
34.80	1683.18	12.48	-9.279	-5.087
34.90	1697.99	12.08	-9.356	-5.126
35.00	1712.79	11.69	-9.619	-5.409
35.20	1727.60	10.95	-9.433	-5.228
35.40	1742.41	10.28	-8.719	-5.608
35.60	1757.21	9.69	-8.804	-5.071
35.80	1772.02	9.22	-8.476	-4.960
36.00	1786.82	8.88	-8.469	-4.701
36.33	1791.05	8.51	-8.446	-4.613
36.67	1795.28	8.23	-8.522	-4.565
37.00	1799.51	8.02	-8.325	-4.496
37.25	1803.74	7.89	-9.661	-5.157
37.50	1807.97	7.78	-8.263	-4.569
37.75	1812.19	7.68	-9.341	-5.313
38.00	1816.42	7.56	-9.029	-4.743
38.33	1820.65	7.38	-9.781	-5.092
38.67	1821.77	7.14	-8.777	-4.702
39.00	1822.89	6.85	-9.729	-4.571
40.00	1824.01	5.80	-8.208	-4.585
41.00	1825.13	4.69	-9.306	-4.981
41.25	1830.96	4.43	-8.658	-4.562
41.50	1836.79	4.20	-9.784	-4.616
41.75	1842.63	3.99	-10.801	-4.472
42.00	1848.46	3.81	-9.359	-4.919
42.50	1854.29	3.54	-10.821	-5.049
43.00	1860.12	3.45	-8.491	-4.402
43.50	1865.95	4.27	-8.200	-4.565
44.00	1871.78	6.21	-8.380	-4.927
44.25	1877.61	7.38	-8.356	-4.663
44.50	1883.45	8.54	-8.394	-4.790
44.75	1889.28	9.61	-8.534	-4.790
45.00	1895.11	10.49	-8.850	-5.385
45.50	1896.49	11.31	-8.493	-4.836
46.00	1897.87	11.24	-9.535	-5.235
47.00	1899.26	10.73	-8.876	-4.599
47.33	1900.64	10.44	-8.432	-4.327
47.67	1902.02	10.10	-8.707	-4.587
48.00	1903.41	9.70	-8.802	-4.809
48.33	1904.79	9.25	-8.409	-4.377
48.67	1906.17	8.73	-8.531	-4.490
49.00	1907.56	8.16	-8.527	-4.490

49.25	1927.37	6.23	-8.323	-4.587
49.50	1947.18	4.52	-8.336	-4.424
49.75	1966.99	4.75	-8.672	-5.057
50.00	1968.94	5.40	-8.120	-4.579
50.17	1970.90	6.02	-8.478	-4.864
50.33	1972.85	6.76	-8.519	-5.111
50.50	1974.80	7.61	-8.354	-4.724
50.67	1976.75	8.53	-8.175	-4.392
50.83	1978.70	9.50	-5.242	-4.868
51.00	1980.66	10.49	-9.802	-5.000
51.25	1982.61	11.99	-8.234	-4.589
51.50	1984.56	13.41	-8.400	-5.015
51.75	1986.51	14.68	-7.430	-4.407
52.00	1988.47	15.72	-8.341	-4.711
52.25	2005.44	16.71	-8.035	-4.205
52.50	2022.41	17.75	-8.015	-4.331
52.75	2039.37	18.57	-7.966	-4.553
53.00	2056.34	18.90	-8.006	-4.232
53.25	2057.59	18.62	-7.968	-4.208
53.50	2058.83	17.89	-7.817	-4.328
53.75	2060.07	16.84	-8.719	-4.896
54.00	2061.31	15.63	-9.645	-5.366
54.25	2062.55	14.41	-9.989	-5.028
54.50	2063.80	13.32	-8.132	-4.513
54.75	2065.04	12.52	-8.426	-4.455
55.00	2066.23	11.99	-8.006	-4.194
55.33	2067.42	11.33	-8.519	-4.381
55.67	2068.60	10.70	-8.161	-4.346
56.00	2069.79	10.11	-8.123	-4.506
56.50	2070.98	9.27	-8.094	-4.372
57.00	2072.17	8.51	-8.301	-4.738
57.33	2073.36	8.04	-8.345	-4.597
57.67	2074.55	7.60	-8.064	-4.407
58.00	2075.74	7.20	-8.191	-4.693
58.33	2076.93	6.83	-8.504	-4.906
58.67	2078.12	6.49	-9.085	-4.777
59.00	2079.31	6.18	-8.262	-4.594
59.25	2080.50	5.97	-8.032	-4.542
59.50	2081.69	5.78	-9.444	-5.552
59.75	2082.88	5.61	-7.172	-4.679
60.00	2084.07	5.45	-8.390	-4.344
60.33	2094.43	5.28	-8.353	-4.872
60.67	2104.79	5.13	-8.287	-4.605
61.00	2115.15	5.02	-8.515	-5.014
61.33	2125.51	4.94	-8.311	-4.607
61.67	2135.88	4.89	-8.249	-4.479
62.00	2146.24	4.87	-8.293	-4.423
62.50	2156.60	5.73	-8.259	-4.521
63.00	2166.96	7.77	-8.438	-4.707
63.25	2173.22	8.99	-8.358	-4.315
63.50	2179.48	10.21	-8.654	-4.676
63.75	2185.74	11.33	-8.188	-4.205
64.00	2192.00	12.25	-7.964	-4.509
64.50	2198.26	13.10	-8.494	-4.663
65.00	2204.52	12.84	-8.199	-4.372
65.50	2210.77	12.03	-8.072	-4.319
66.00	2217.03	10.69	-8.080	-4.267
66.25	2217.48	9.37	-8.088	-4.230
66.50	2217.92	7.51	-8.084	-4.495
66.75	2218.37	5.86	-7.925	-4.349
67.00	2218.82	5.14	-8.031	-4.379
67.50	2245.00	5.27	-8.008	-4.158

68.00	2271.18	5.64	-7.782	-4.130
68.33	2275.06	6.02	-7.830	-4.059
68.67	2278.95	6.51	-7.716	-3.917
69.00	2282.83	7.12	-7.888	-4.199
69.33	2286.72	8.16	-7.930	-4.106
69.67	2290.61	9.76	-7.949	-4.174
70.00	2294.49	11.58	-7.935	-4.107
70.33	2298.38	13.29	-7.836	-4.260
70.67	2302.26	14.56	-7.804	-4.089
71.00	2306.15	15.06	-7.912	-4.338
71.33	2308.28	12.53	-7.869	-4.280
71.67	2310.41	11.48	-7.855	-4.078
72.00	2318.71	11.28	-7.894	-4.300
72.25	2327.01	11.14	-7.888	-4.145
72.50	2335.31	11.01	-7.877	-4.070
72.75	2343.61	10.89	-7.920	-4.117
73.00	2351.91	10.78	-7.978	-4.447
73.33	2360.21	10.64	-8.103	-4.210
73.67	2368.52	10.52	-8.165	-4.251
74.00	2376.82	10.42	-8.246	-4.227
74.25	2385.12	10.35	-8.367	-4.549
74.50	2393.42	10.29	-8.264	-4.207
74.75	2401.72	10.24	-8.354	-4.357
75.00	2410.02	10.20	-8.430	-4.636
75.25	2418.32	10.17	-8.485	-4.625
75.50	2426.62	10.15	-8.321	-4.518
75.75	2434.92	10.13	-8.285	-4.239
76.00	2443.23	10.13	-8.282	-4.337
76.33	2448.93	10.13	-8.275	-4.767
76.67	2454.64	10.14	-8.387	-4.533
77.00	2460.34	10.16	-8.471	-4.607
77.25	2466.05	10.17	-8.614	-4.705
77.50	2471.75	10.19	-8.658	-4.617
77.75	2477.46	10.21	-8.538	-4.640
78.00	2483.16	10.24	-8.472	-4.666
78.33	2488.87	10.28	-8.403	-4.491
78.67	2490.63	10.33	-8.361	-4.206
79.00	2492.39	10.38	-8.427	-4.479
79.33	2494.15	10.43	-8.467	-4.567
79.67	2495.92	10.50	-8.659	-4.823
80.00	2497.68	10.58	-9.095	-4.912
80.25	2499.44	10.66	-9.019	-5.106
80.50	2501.20	10.74	-8.710	-4.727
