NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering
Washington, DC

February 26, 2001

Recorded Radar Study

Monique Heiligers

A. ACCIDENT

Location:	Rancho Cordova, California
Date:	February 16, 2000
Time:	1951 Local Time
Aircraft:	Douglas DC-8-71, N8079U
Operator:	Emery Worldwide Airlines, A CNF Company (FAR Part 121 Supplemental)
NTSB#:	DCA-00-MA-026

B. GROUP

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C. SUMMARY

On February 16, 2000, approximately 1951 local time, Emery Worldwide Airlines flight EB017, tail number N8079U, crashed approximately 1.5 NM east of the approach end of runway 22L at Sacramento Mather Field (MHR). The accident airplane had just taken off from runway 22L at Mather Field.

D. DETAILS OF INVESTIGATION

Introduction

Radar data from the Sacramento ASR9 facility were obtained from the FAA and processed for this study. The beacon code used by the Emery Flight 17 is 3274.

FAA data

The Sacramento ASR9 facility is located at 38:40:26.7 N and 121:21:55.8 W. The data relating to the Emery Flight 17 were identified using the unique beacon code and were subsequently separated out.

The radar data set contained the position of the airplane in polar coordinates in terms of range, azimuth and altitude relative to the radar location. To be able to project the ground track of the airplane onto a map the data were converted to a rectangular Cartesian axis system, using a 16 deg east magnetic variation and a 110 ft elevation. The origin of this rectangular coordinate system is at the radar location and the x- and y-axis are pointing true east and true north respectively. The radar track of the aircraft obtained by this conversion is shown in figure 1. Selected comments from the Air Traffic Control transcript are included in the plot.

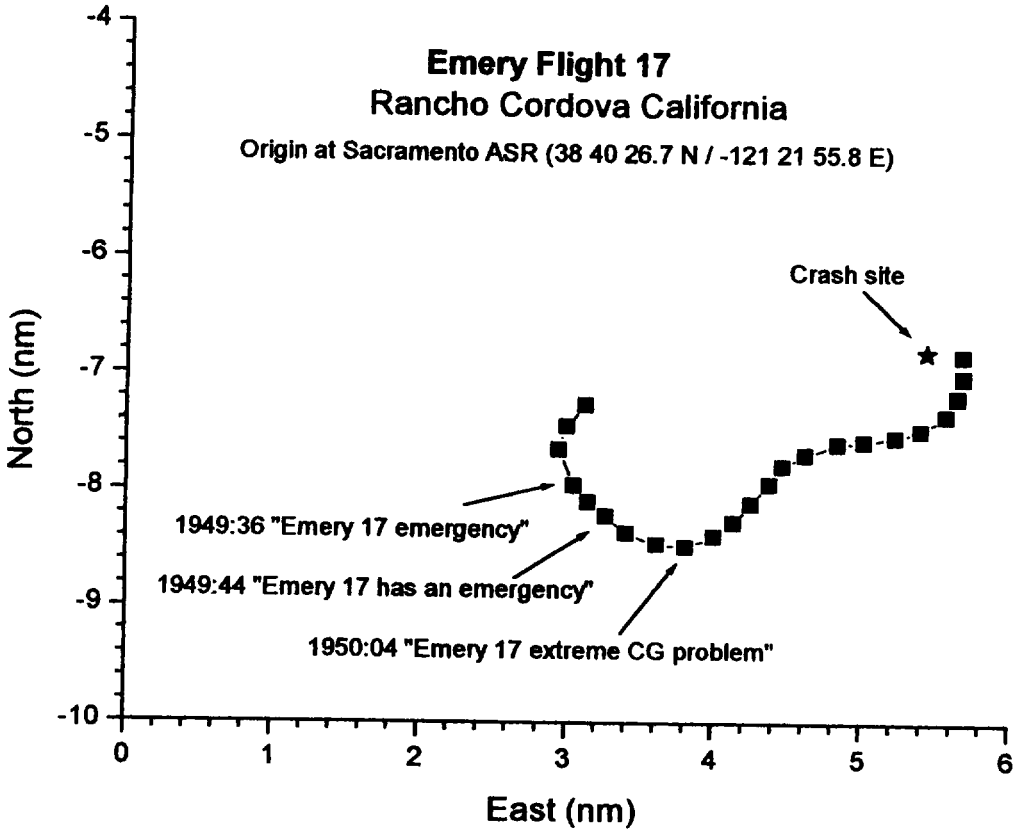

Figure 1: Ground track

From figure 1 it can be seen that the last radar return is recorded at a position 0.03 Nm South and 0.24 Nm East of the actual crash site. The uncertainties for this radar study are shown in figure 2, where a box is drawn around each radar point. At the time of the radar return the airplane could have been anywhere inside that box. Note also that the last radar return is recorded at an altitude of 400 ft, 260 ft above the ground and that the time between the radar returns is approximately 4.6 seconds.

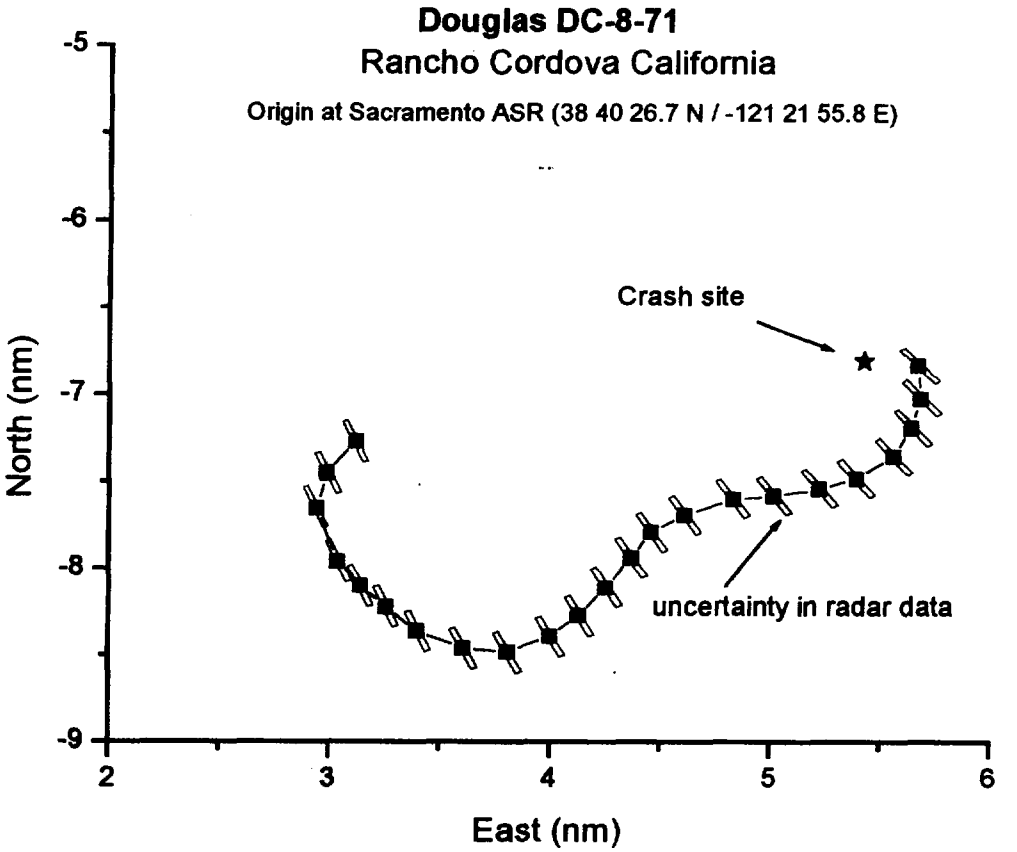

Figure 2: Uncertainties in radar data

To give a better impression of the location of the crash site and the flight track, the ground track is projected on a map in the figure below.

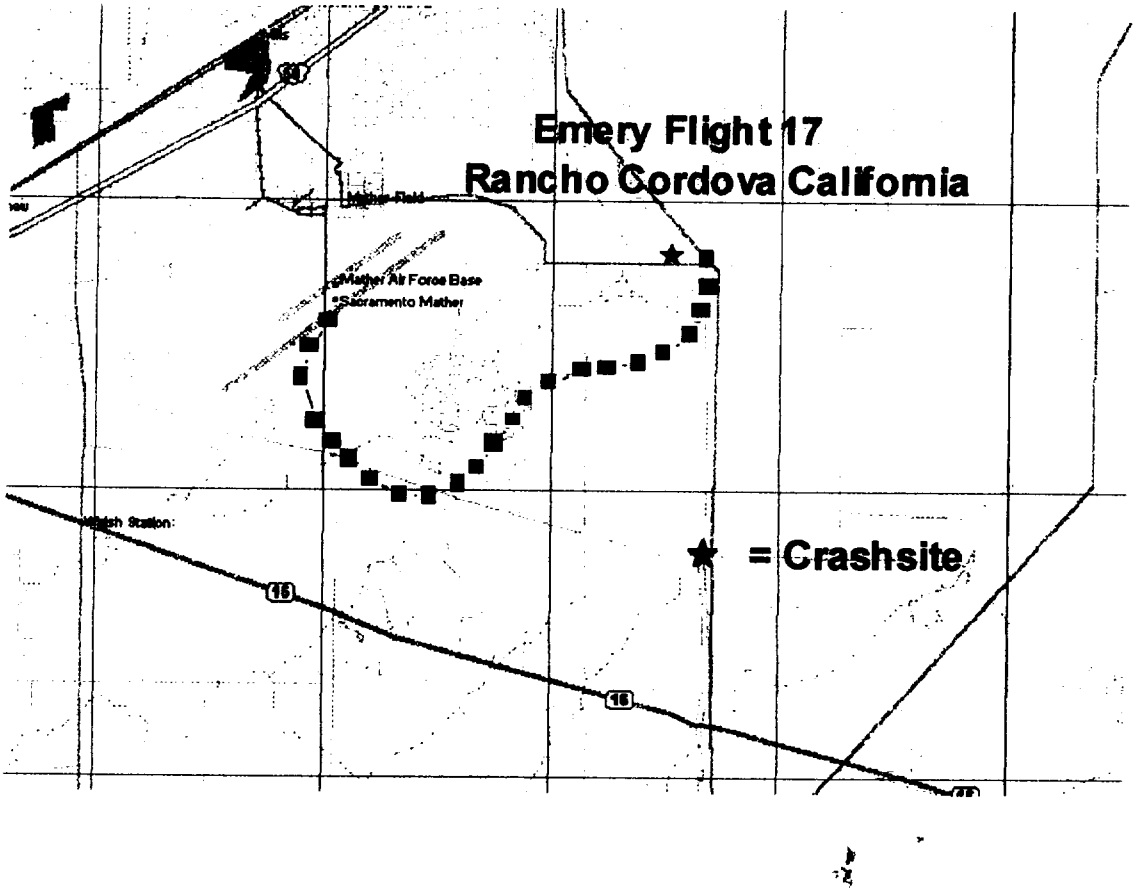

Figure 3: Ground track on map

Altitude from the transponder returns of the Emery Flight 17 is plotted as a function of time in the following figure.

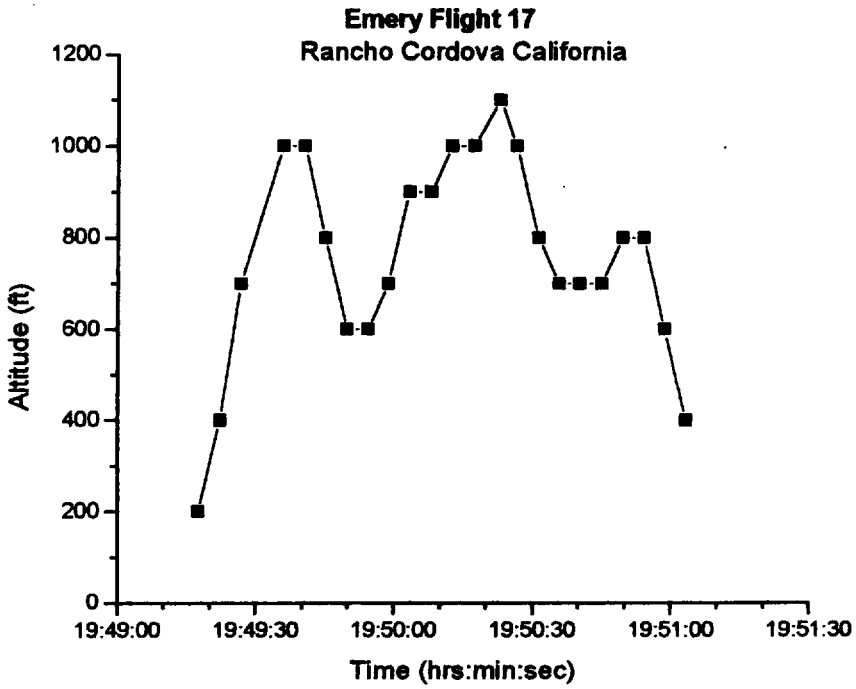

Figure 4: Altitude

With the radar returns for the aircraft isolated and converted to position, ground speed is determined by calculating the three-dimensional distance between the radar points and dividing this by the time between the radar returns. This ground speed is plotted in figure 5.

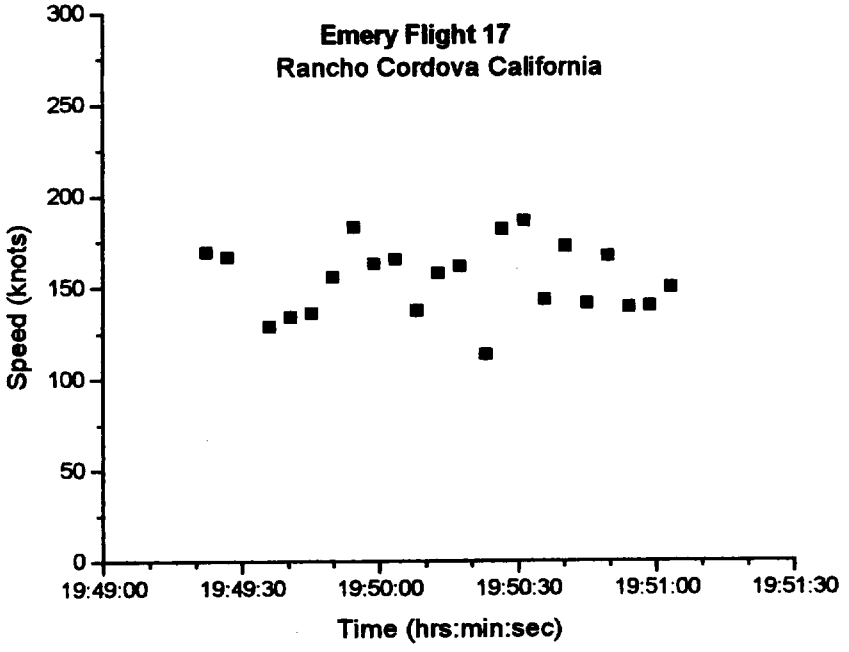

Figure 5: Ground speed

The ground track and altitude are combined into a three-dimensional plot in figure 6.

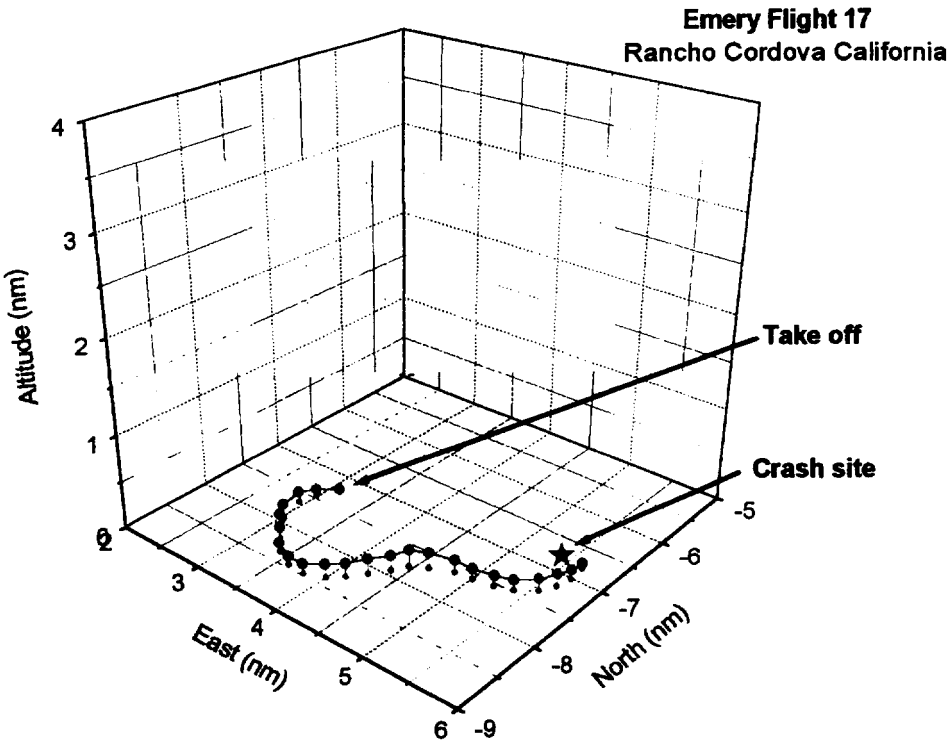

Figure 6: Three-dimensional flight path

The three-dimensional plot is presented in figure 7 with the altitude scale expanded from true scale for clarity.

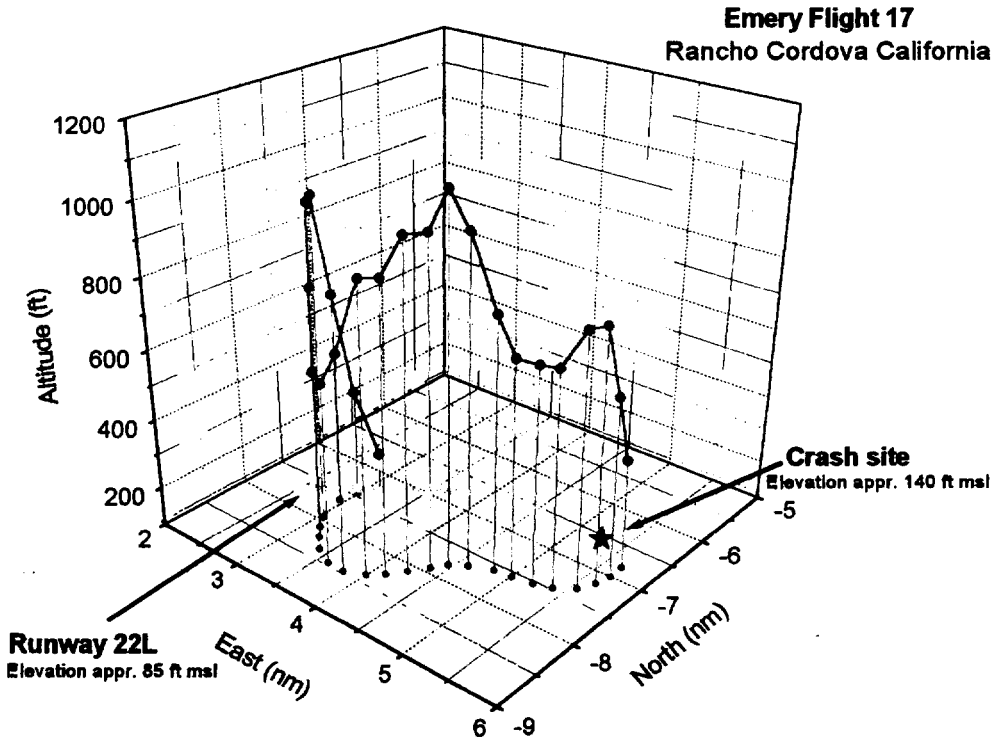

Figure 7: Three-dimensional flight path, expanded altitude scale

Emery Flight 17 entered a climbing left turn immediately after taking off from runway 22L at Sacramento Mather Field (MHR). After approximately 23 seconds the aircraft reached an altitude of approximately 1000 ft msl and subsequently entered a dive. Fourteen seconds later at 600 ft it started to climb again until it reached an altitude of 1100 ft about 28 seconds later. From this point the airplane started another dive, descended 400 ft in 13 seconds to an altitude of 700 ft, and then climbed to 800 ft again. At 800 ft the aircraft entered a final dive, descended 660 ft and crashed at an altitude of 140 ft msl, approximately 1.5 NM east of the approach end of runway 22L at Sacramento Mather Field.

During the entire flight the ground speed varied between 125 and 175 knots.

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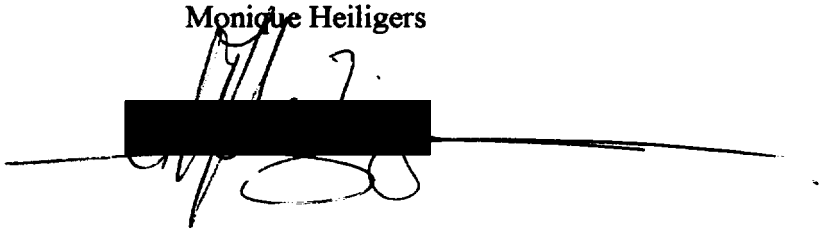

Appendix 1: processed radar data from Sacramento ASR 9 facility

Processed radar data from Sacramento ASR 9 facility

Radar Time (sec)	Radar Time Days	Local Time (sec)	Local Time Days	Azmuth (deg)	Slt_Range (N MI)	Altitude (ft)	Altitude (nm)	Elevation (deg)
2957.447	0.034229711	71357.447	0.825896377	140.8	7.91	200	0.032916392	0.11
2962.218	0.034284931	71362.218	0.825951597	142.12	8.03	400	0.065832785	0.34
2966.802	0.034337986	71366.802	0.826004653	143	8.19	700	0.115207373	0.68
2976.015	0.034444618	71376.015	0.826111285	143.09	8.52	1000	0.164581962	0.99
2980.644	0.034498194	71380.644	0.826164861	142.82	8.69	1000	0.164581962	0.97
2985.219	0.034551146	71385.219	0.826217813	142.38	8.84	800	0.131665569	0.74
2989.86	0.034604861	71389.86	0.826271528	141.85	9.03	600	0.098749177	0.51
2994.444	0.034657917	71394.444	0.826324583	140.89	9.2	600	0.098749177	0.5
2998.904	0.034709537	71398.904	0.826376204	139.83	9.3	700	0.115207373	0.6
3003.539	0.034763183	71403.539	0.82642985	138.52	9.3	900	0.148123766	0.8
3008.178	0.034816875	71408.178	0.826483542	137.46	9.25	900	0.148123766	0.81
3012.758	0.034869884	71412.758	0.826536551	136.32	9.16	1000	0.164581962	0.92
3017.394	0.034923542	71417.394	0.826590208	135.18	9.06	1000	0.164581962	0.93
3022.979	0.034988183	71422.979	0.82665485	134.21	8.98	1100	0.181040158	1.04
3026.569	0.035029734	71426.569	0.8266964	133.07	8.97	1000	0.164581962	0.94
3031.212	0.035083472	71431.212	0.826750139	131.57	9	800	0.131665569	0.72
3035.789	0.035136447	71435.789	0.826803113	130.52	9.09	700	0.115207373	0.61
3040.26	0.035188194	71440.26	0.826854861	129.29	9.17	700	0.115207373	0.61
3044.863	0.03524147	71444.863	0.826908137	128.23	9.22	700	0.115207373	0.6
3049.492	0.035295046	71449.492	0.826961713	126.91	9.22	800	0.131665569	0.71
3054.122	0.035348634	71454.122	0.827015301	125.86	9.14	800	0.131665569	0.71
3058.703	0.035401655	71458.703	0.827068322	124.98	9.03	600	0.098749177	0.51
3063.346	0.035455394	71463.346	0.82712206	124.28	8.88	400	0.065832785	0.31

Processed radar data from Sacramento ASR 9 facility

Local Time (sec)	Local Time Days	Gnd_Range (N MI)	East (N MI)	North (N MI)	East_min (N MI)	East_max (N MI)	North_min (N MI)	North_max (N MI)	speed (nm/s)	Speed (knots)
71357.447	0.825896377	7.91	3.12	-7.27	3.18	3.06	-7.15	-7.39		
71362.218	0.825951597	8.03	2.99	-7.45	3.05	2.93	-7.33	-7.57	0.0470473	169.370279
71366.802	0.826004653	8.19	2.94	-7.65	2.99	2.88	-7.52	-7.77	0.046244654	166.4807551
71376.015	0.826111285	8.52	3.04	-7.96	3.1	2.98	-7.84	-8.08	0.035759343	128.7336363
71380.644	0.826164861	8.69	3.14	-8.1	3.2	3.08	-7.98	-8.22	0.0371671	133.8015596
71385.219	0.826217813	8.84	3.26	-8.22	3.32	3.2	-8.1	-8.34	0.037785446	136.0276052
71389.86	0.826271528	9.03	3.4	-8.36	3.46	3.34	-8.24	-8.48	0.0432466	155.6877603
71394.444	0.826324583	9.2	3.61	-8.46	3.67	3.55	-8.34	-8.58	0.050740416	182.6654976
71398.904	0.826376204	9.3	3.81	-8.48	3.87	3.74	-8.36	-8.6	0.045217535	162.7831264
71403.539	0.82642985	9.3	4	-8.39	4.07	3.93	-8.28	-8.51	0.045911365	165.2809126
71408.178	0.826483542	9.25	4.13	-8.27	4.2	4.06	-8.16	-8.39	0.038137111	137.2936013
71412.758	0.826536551	9.16	4.25	-8.11	4.33	4.18	-7.99	-8.23	0.043815729	157.7366237
71417.394	0.826590208	9.06	4.37	-7.94	4.44	4.3	-7.82	-8.05	0.044884927	161.5857363
71422.979	0.82665485	8.98	4.46	-7.79	4.54	4.39	-7.68	-7.91	0.031459461	113.2540583
71426.569	0.8266964	8.97	4.61	-7.69	4.69	4.53	-7.58	-7.81	0.050425423	181.5315235
71431.212	0.826750139	9	4.83	-7.6	4.9	4.75	-7.48	-7.71	0.051683308	186.0599091
71435.789	0.826803113	9.09	5.01	-7.58	5.1	4.93	-7.47	-7.69	0.039732136	143.0356892
71440.26	0.826854861	9.17	5.22	-7.54	5.3	5.14	-7.43	-7.65	0.047813819	172.1297472
71444.863	0.826908137	9.22	5.39	-7.48	5.47	5.3	-7.37	-7.59	0.039165232	140.9948359
71449.492	0.826961713	9.22	5.56	-7.35	5.65	5.47	-7.25	-7.46	0.046368819	166.9277491
71454.122	0.827015301	9.14	5.64	-7.19	5.73	5.56	-7.08	-7.3	0.038636164	139.0901895
71458.703	0.827068322	9.03	5.68	-7.02	5.77	5.6	-6.91	-7.12	0.038794464	139.6600716
71463.346	0.82712206	8.88	5.67	-6.83	5.77	5.58	-6.73	-6.93	0.041587191	149.7138883