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L3HARRIS™

UAS XCEL ENERGY BVLOS PROJECT AIRSPACE ANALYSIS

CAT062 Track Counts and P(LWC)

July 17, 2020   **TONY BOCI | Systems Engineering Scientist, Surveillance & Automation Solutions**
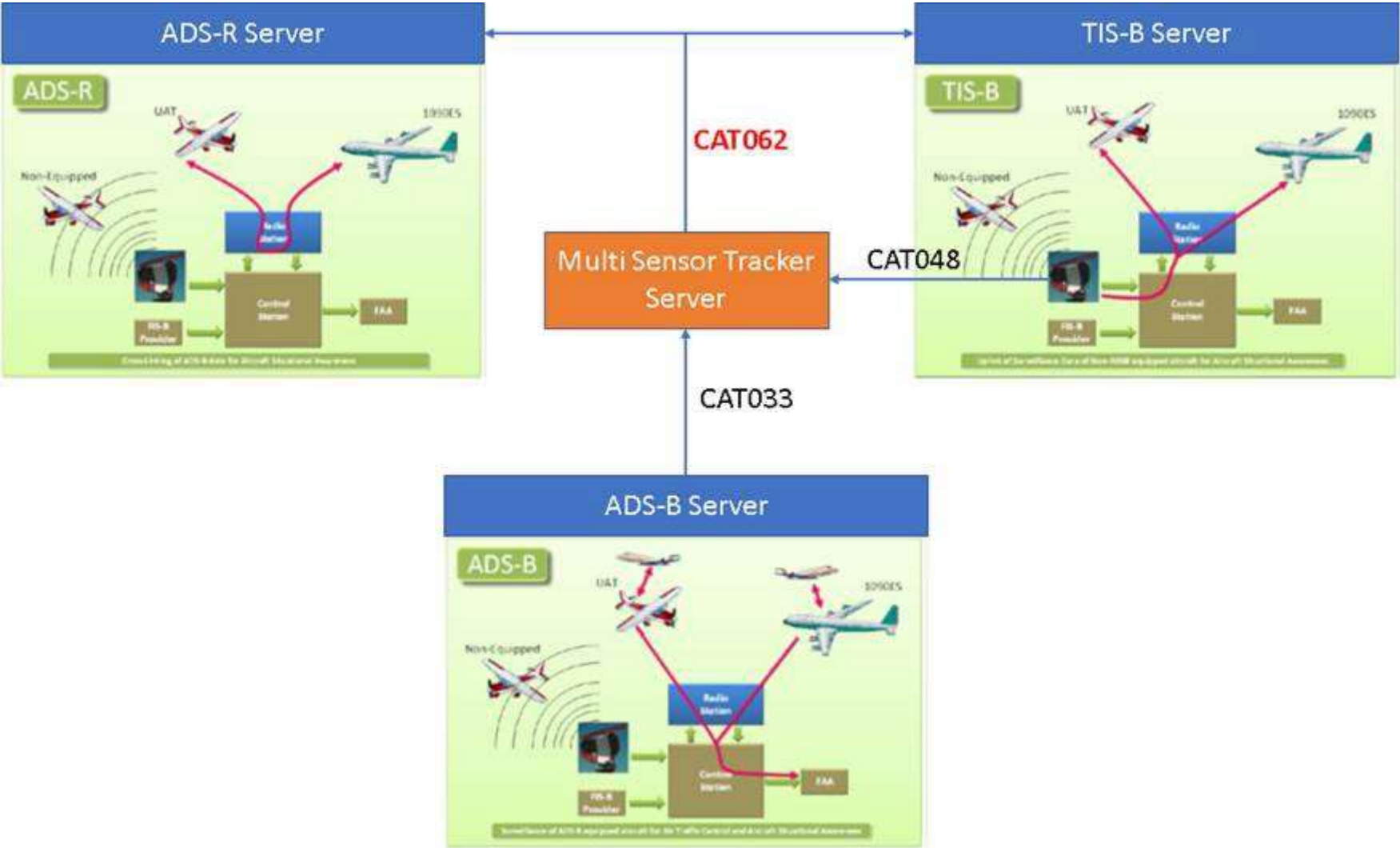
Outline

- **Xcel Powerline SOW1 Sample Area**

- **MST CAT062 track analysis Section 1 (MSP)**

- **P(LWC - loss of well clear) Section 1 (MSP) and Section 2 (RST)**
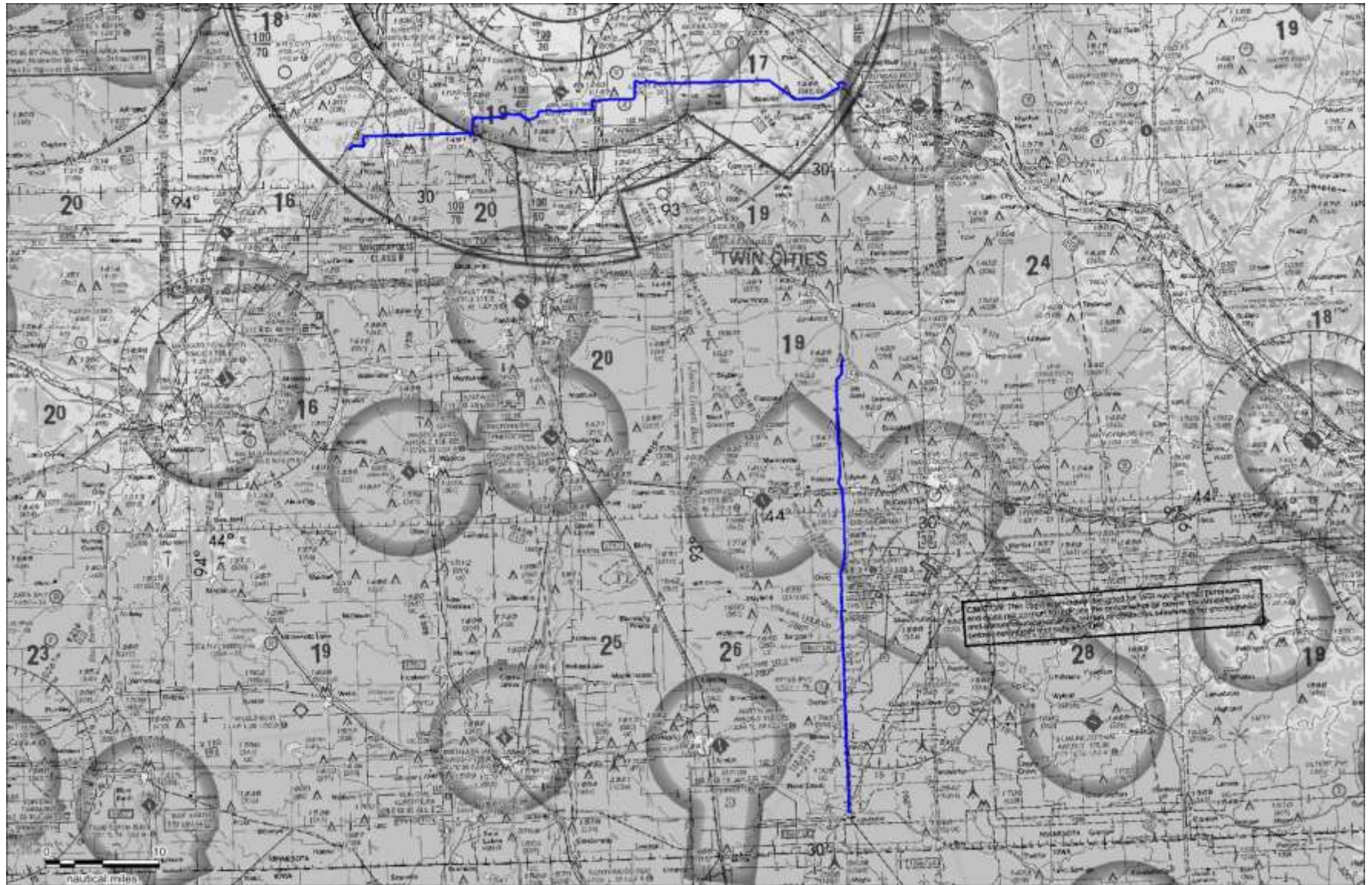
Analysis Originally Developed and Presented in 2018 in support of FAA Certificate of Waiver 107W-2019-00055B

Surveillance and Broadcast Services System (SBSS) Surveillance Data

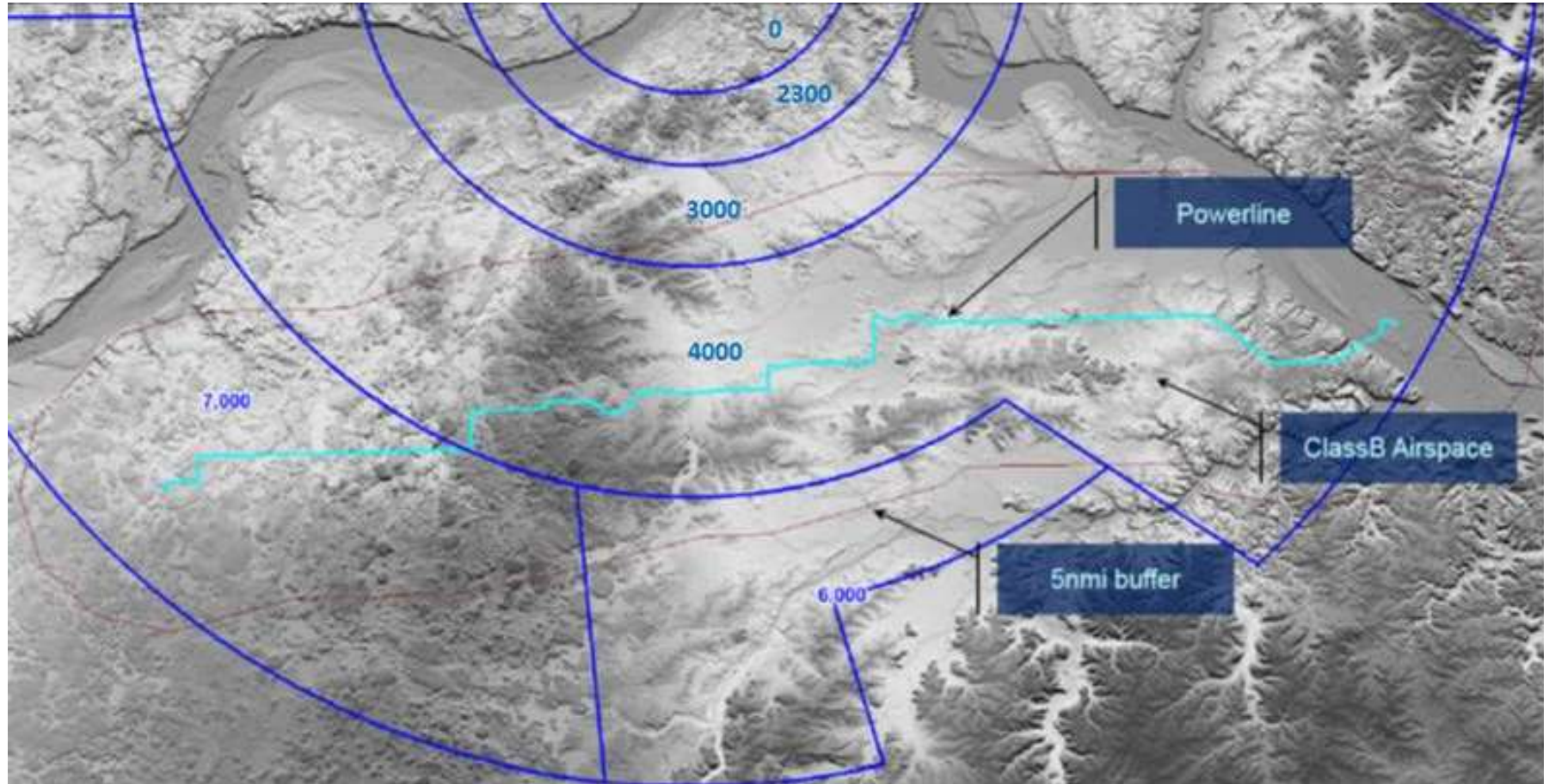# MST CAT062s Reports Below 800ft AGL (uncorrected pressure altitude)
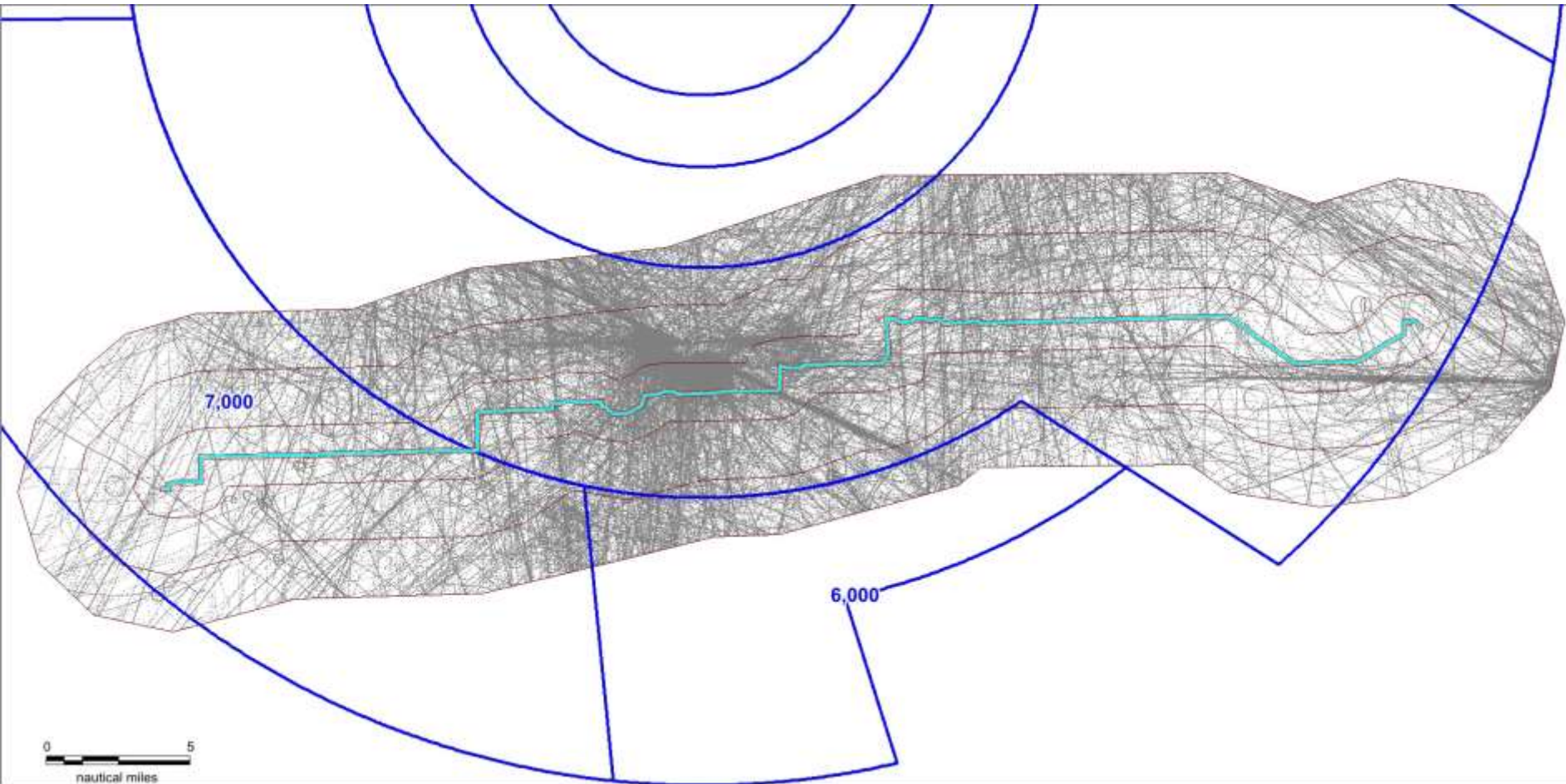
MST CAT062 Tracks Below 700ft AGL (East) (uncorrected pressure altitude)

0   2.5

nautical miles

MST CAT062 Tracks Below 700ft AGL (West) (uncorrected pressure altitude)

0   2.5

nautical miles

The Digital Obstacle File (updated every 56 days) describes all known obstacles of interest to aviation users in the United States, with limited coverage of the Pacific, the Caribbean, Canada, and Mexico. The obstacles are assigned unique numerical identifiers; accuracy codes, and listed in order by state.

(500ft buffer and <1000ft MSL ~ 100ft AGL)

Track count analysis of Xcel Powerline Section 1
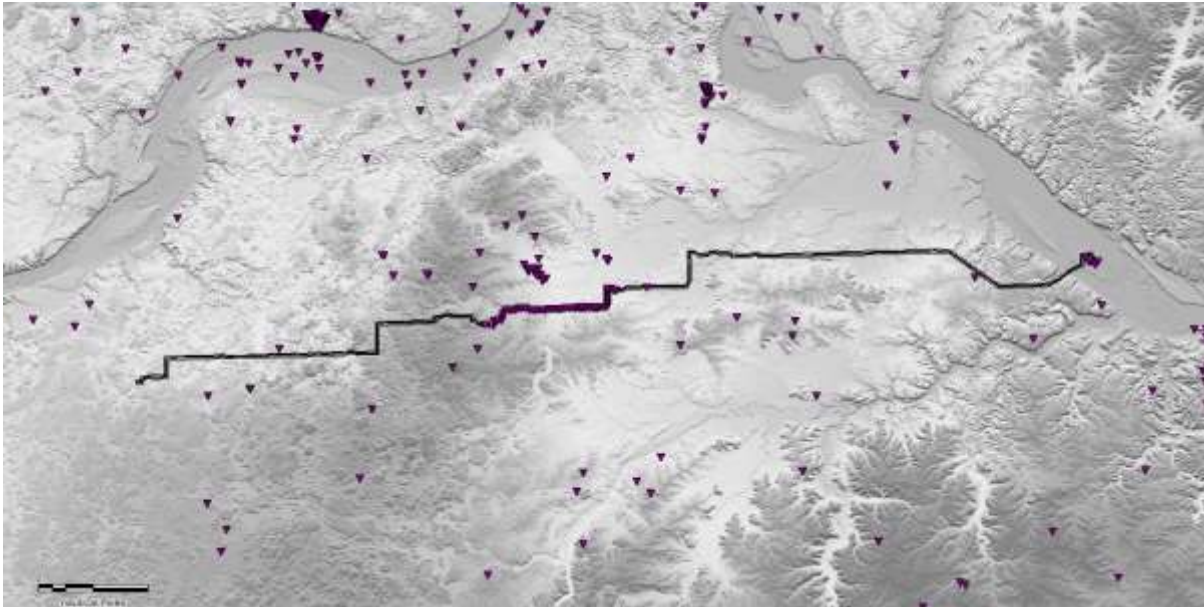
Airlake Airport
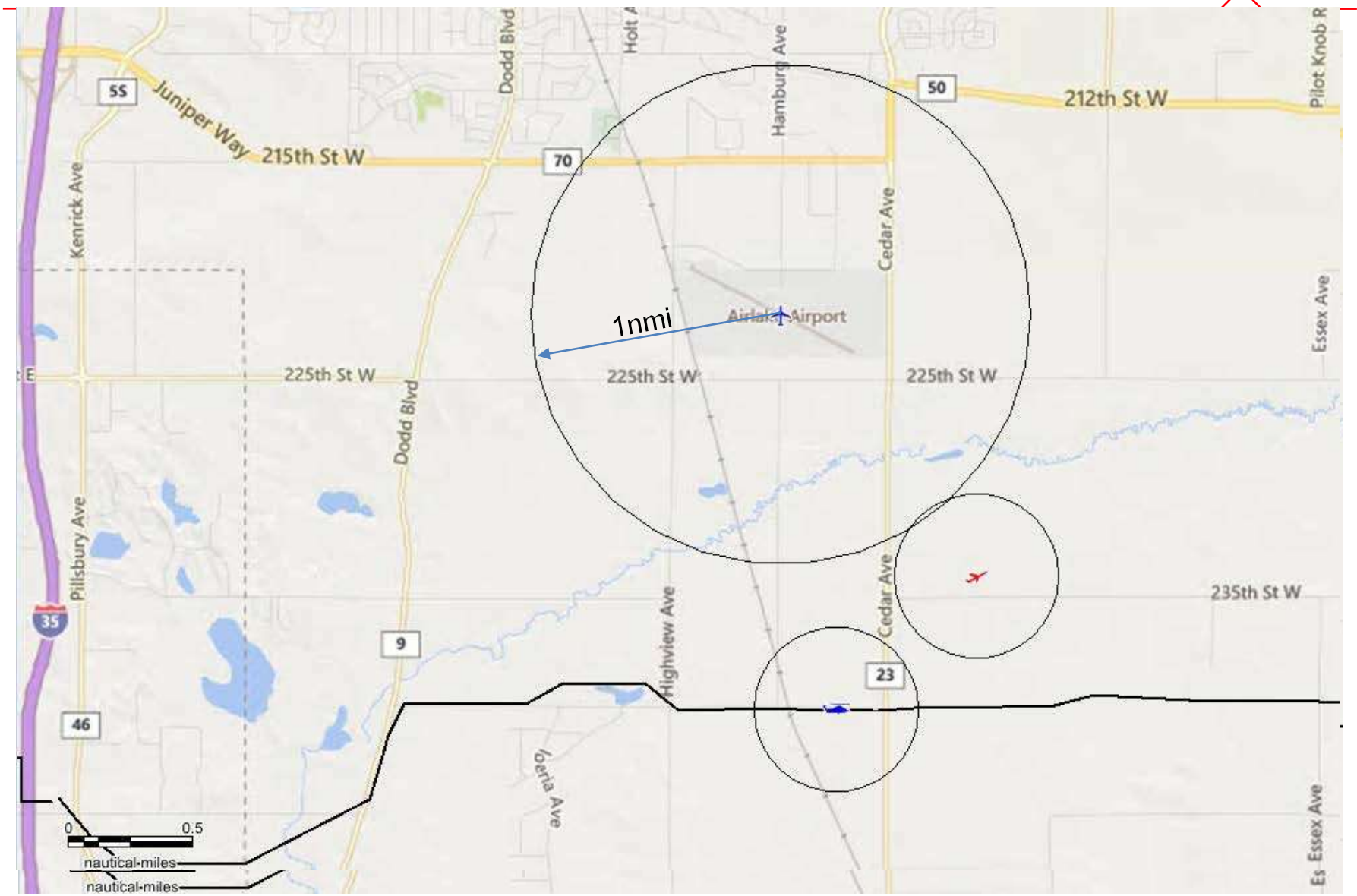
Altimeter Setting: Airlake (KLVN) 1-14 July 2018

Barometer (Hg)
Airlake, MN
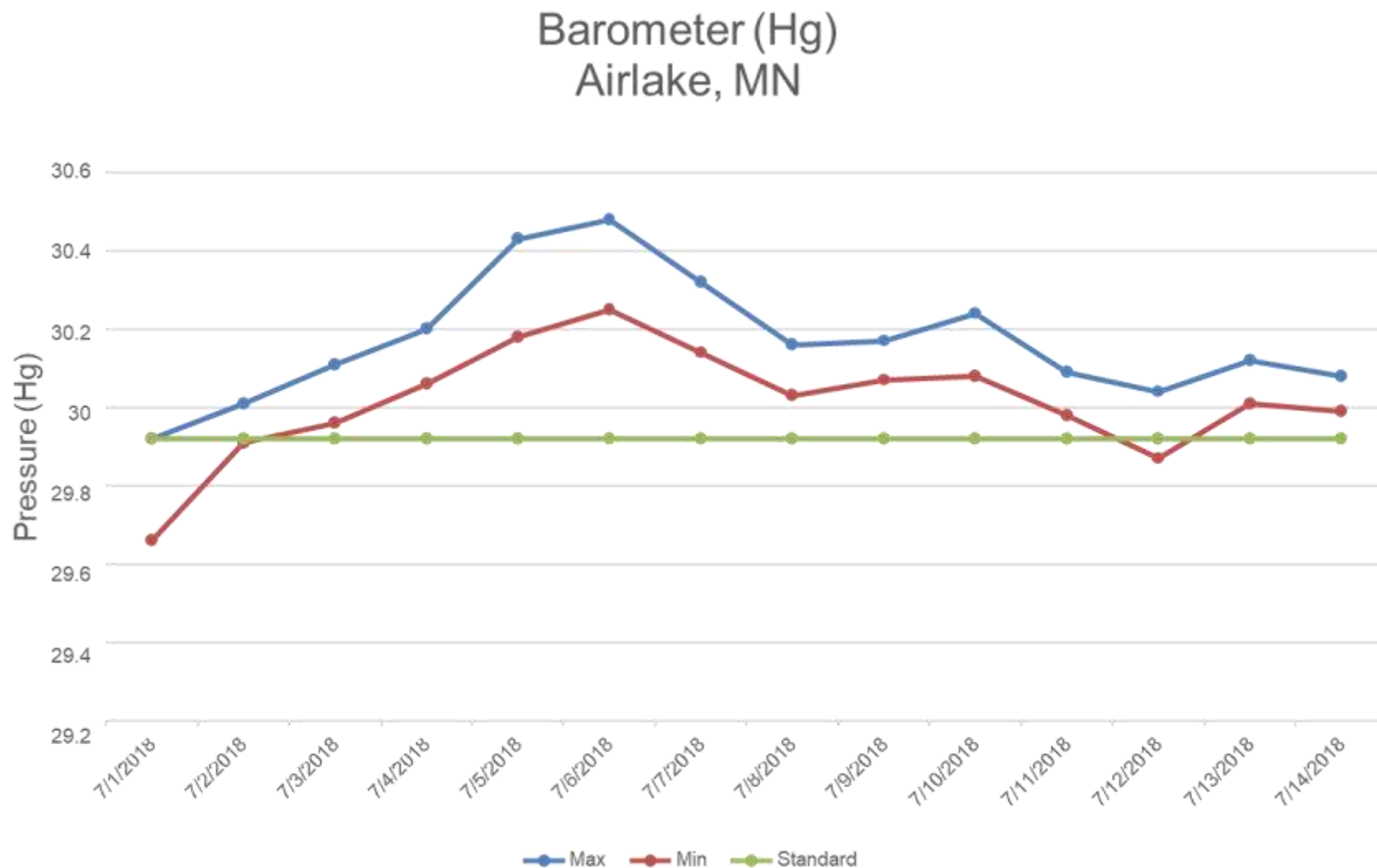
Weather MSP: 1-14 July 2018
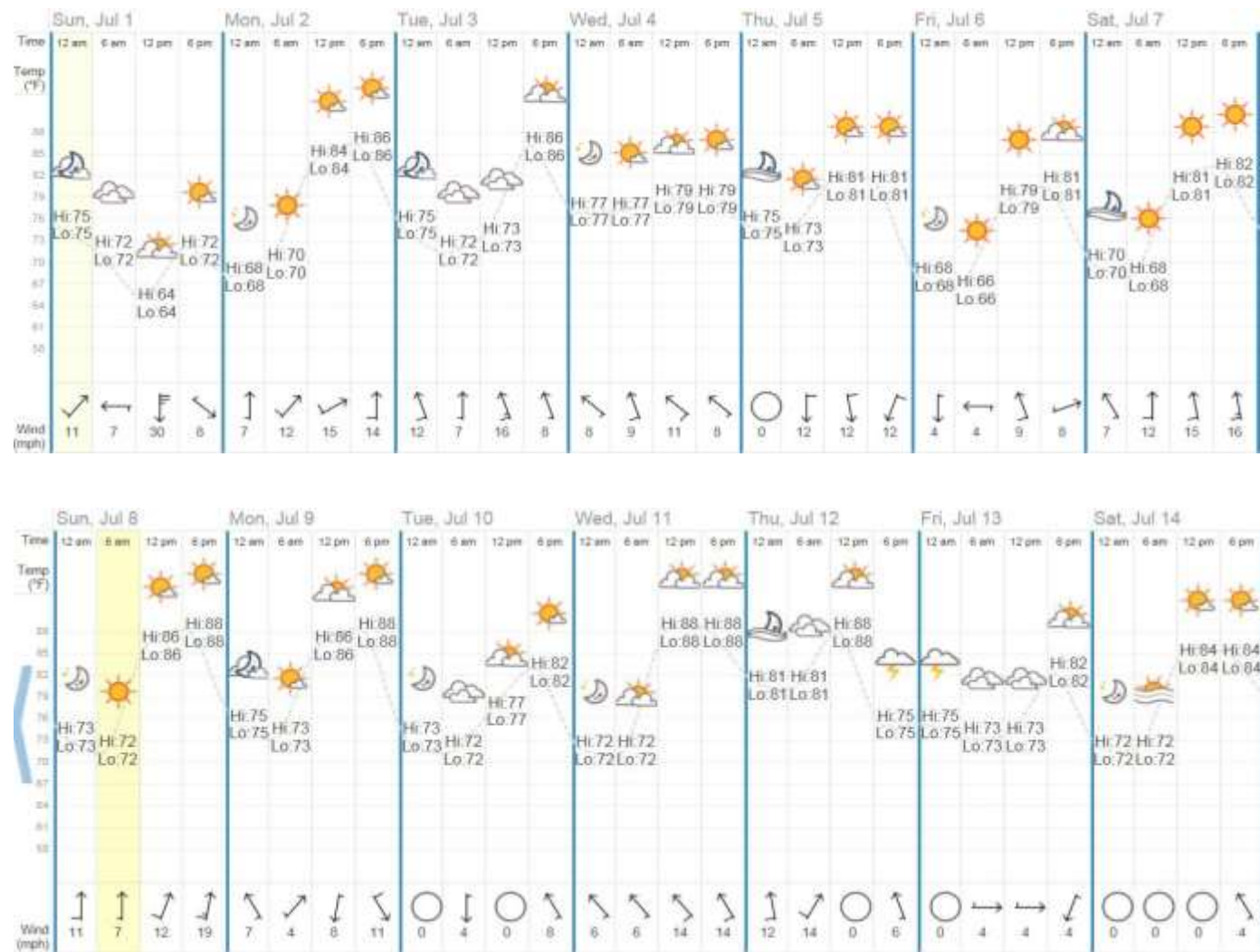
CAT062: Powerline Section 1 (East)
(500ft buffer and <1000ft MSL ~ 100ft AGL)

track_number	cntTrack_number	cntSensors	clusterSensors	clusterTarget_address	minTrack_Alt	maxTrack_Alt	avgTrack_Alt
2548	8	1	[PSR SSR]	[0009f4]	500.0	750.0	671.9
1268	5	1	[PSR SSR]	[0004f4]	700.0	725.0	710.0
188	5	1	[PSR SSR]	[0000bc]	900.0	925.0	905.0
2555	4	1	[PSR SSR]	[0009fb]	800.0	900.0	875.0
786	3	1	[PSR SSR]	[000312]	900.0	900.0	900.0
494	2	1	[PSR SSR UAT]	[a1a9a4]	925.0	925.0	925.0

Number of Radar tracks: 5
Number of ADS-B tracks: 1
Total number of tracks: 6

CAT062: Powerline Section 1 (East)
(500ft buffer and <1100ft MSL ~ 200ft AGL)

track_number	cntTrack_number	cntSensors	clusterSensors	clusterTarget_address	minTrack_Alt	maxTrack_Alt	avgTrack_Alt
494	8	1	[PSR SSR UAT]	[a1a9a4]	925.0	1025.0	987.5
2548	8	1	[PSR SSR]	[0009f4]	500.0	750.0	671.9
786	6	1	[PSR SSR]	[000312]	900.0	1025.0	954.2
188	6	1	[PSR SSR]	[0000bc]	900.0	1000.0	920.8
1268	5	1	[PSR SSR]	[0004f4]	700.0	725.0	710.0
2555	4	1	[PSR SSR]	[0009fb]	800.0	900.0	875.0

Number of Radar tracks: 5
Number of ADS-B tracks: 1
Total number of tracks: 6

CAT062: Powerline Section 1 (East)
(500ft buffer and <1200ft MSL ~ 300ft AGL)

track_number	cntTrack_number	cntSensors	clusterSensors	clusterTarget_address	minTrack_Alt	maxTrack_Alt	avgTrack_Alt
2555	22	1	[PSR SSR]	[0009fb]	800.0	1175.0	1065.9
786	10	1	[PSR SSR]	[000312]	900.0	1100.0	1012.5
494	8	1	[PSR SSR UAT]	[a1a9a4]	925.0	1025.0	987.5
2548	8	1	[PSR SSR]	[0009f4]	500.0	750.0	671.9
188	6	1	[PSR SSR]	[0000bc]	900.0	1000.0	920.8
1318	5	1	[PSR SSR 1090]	[a4038a]	1150.0	1175.0	1165.0
1268	5	1	[PSR SSR]	[0004f4]	700.0	725.0	710.0
1744	4	1	[PSR SSR]	[0006d0]	1100.0	1100.0	1100.0
1577	1	1	[PSR SSR]	[000629]	1175.0	1175.0	1175.0

Number of Radar tracks: 7
Number of ADS-B tracks: 2
Total number of tracks: 9

CAT062: Powerline Section 1 (East)
(500ft buffer and <1300ft MSL ~ 400ft AGL)

track_number	cntTrack_number	cntSensors	clusterSensors	clusterTarget_address	minTrack_Alt	maxTrack_Alt	avgTrack_Alt
2555	28	1	[PSR SSR]	[0009fb]	800.0	1200.0	1094.6
4031	25	1	[PSR SSR]	[000fbf]	1200.0	1250.0	1202.0
786	10	1	[PSR SSR]	[000312]	900.0	1100.0	1012.5
494	8	1	[PSR SSR UAT]	[a1a9a4]	925.0	1025.0	987.5
2548	8	1	[PSR SSR]	[0009f4]	500.0	750.0	671.9
117	6	1	[PSR SSR 1090]	[a8011d]	1225.0	1275.0	1262.5
188	6	1	[PSR SSR]	[0000bc]	900.0	1000.0	920.8
1318	5	1	[PSR SSR 1090]	[a4038a]	1150.0	1175.0	1165.0
1268	5	1	[PSR SSR]	[0004f4]	700.0	725.0	710.0
1744	4	1	[PSR SSR]	[0006d0]	1100.0	1100.0	1100.0
1577	3	1	[PSR SSR]	[000629]	1175.0	1200.0	1191.7
2426	1	1	[PSR SSR]	[00097a]	1200.0	1200.0	1200.0
2024	1	1	[PSR SSR]	[0007e8]	1275.0	1275.0	1275.0
2417	1	1	[PSR SSR UAT]	[a1a9a4]	1275.0	1275.0	1275.0

Number of Radar tracks: 10
Number of ADS-B tracks: 4
Total number of tracks: 14

CAT062: Powerline Section 1 (East)
(500ft buffer and <1400ft MSL ~ 500ft AGL)

track_number	cntTrack_number	cntSensors	clusterSensors	clusterTarget_address	minTrack_Alt	maxTrack_Alt	avgTrack_Alt
2555	33	1	[PSR SSR]	[0009fb]	800.0	1300.0	1125.8
4031	28	1	[PSR SSR]	[000fbf]	1200.0	1300.0	1212.5
1932	13	1	[PSR SSR 1090]	[a30a7b]	1300.0	1300.0	1300.0
786	10	1	[PSR SSR]	[000312]	900.0	1100.0	1012.5
494	8	1	[PSR SSR UAT]	[a1a9a4]	925.0	1025.0	987.5
2548	8	1	[PSR SSR]	[0009f4]	500.0	750.0	671.9
117	6	1	[PSR SSR 1090]	[a8011d]	1225.0	1275.0	1262.5
188	6	1	[PSR SSR]	[0000bc]	900.0	1000.0	920.8
2417	6	1	[PSR SSR UAT]	[a1a9a4]	1275.0	1325.0	1308.3
1318	5	1	[PSR SSR 1090]	[a4038a]	1150.0	1175.0	1165.0
1268	5	1	[PSR SSR]	[0004f4]	700.0	725.0	710.0
1744	4	1	[PSR SSR]	[0006d0]	1100.0	1100.0	1100.0
2459	4	1	[PSR SSR]	[00099b]	1300.0	1300.0	1300.0
1577	3	1	[PSR SSR]	[000629]	1175.0	1200.0	1191.7
2429	2	1	[PSR SSR]	[00097d]	1300.0	1300.0	1300.0
174	2	1	[PSR SSR]	[0000ae]	1325.0	1325.0	1325.0
2426	1	1	[PSR SSR]	[00097a]	1200.0	1200.0	1200.0
2024	1	1	[PSR SSR]	[0007e8]	1275.0	1275.0	1275.0

Number of Radar tracks: 13
Number of ADS-B tracks: 5
Total number of tracks: 18

CAT062: Powerline Section 1 (East)
(500ft buffer and <1500ft MSL ~ 600ft AGL)

track_number	cntTrack_number	cntSensors	clusterSensors	clusterTarget_address	minTrack_Alt	maxTrack_Alt	avgTrack_Alt
2555	33	1	[PSR SSR]	[0009fb]	800.0	1300.0	1125.8
4031	28	1	[PSR SSR]	[000fbf]	1200.0	1300.0	1212.5
1932	13	1	[PSR SSR 1090]	[a30a7b]	1300.0	1300.0	1300.0
2417	11	1	[PSR SSR UAT]	[a1a9a4]	1275.0	1450.0	1368.2
786	10	1	[PSR SSR]	[000312]	900.0	1100.0	1012.5
494	8	1	[PSR SSR UAT]	[a1a9a4]	925.0	1025.0	987.5
2548	8	1	[PSR SSR]	[0009f4]	500.0	750.0	671.9
117	6	1	[PSR SSR 1090]	[a8011d]	1225.0	1275.0	1262.5
188	6	1	[PSR SSR]	[0000bc]	900.0	1000.0	920.8
1318	5	1	[PSR SSR 1090]	[a4038a]	1150.0	1175.0	1165.0
1126	5	1	[PSR SSR 1090]	[a00393]	1400.0	1400.0	1400.0
1268	5	1	[PSR SSR]	[0004f4]	700.0	725.0	710.0
174	5	1	[PSR SSR]	[0000ae]	1325.0	1400.0	1370.0
1744	4	1	[PSR SSR]	[0006d0]	1100.0	1100.0	1100.0
2459	4	1	[PSR SSR]	[00099b]	1300.0	1300.0	1300.0
537	3	1	[PSR SSR]	[000219]	1400.0	1400.0	1400.0
1577	3	1	[PSR SSR]	[000629]	1175.0	1200.0	1191.7
2237	2	1	[PSR SSR]	[0008bd]	1400.0	1400.0	1400.0
2429	2	1	[PSR SSR]	[00097d]	1300.0	1300.0	1300.0
1391	1	1	[PSR SSR]	[00056f]	1475.0	1475.0	1475.0
2426	1	1	[PSR SSR]	[00097a]	1200.0	1200.0	1200.0
2024	1	1	[PSR SSR]	[0007e8]	1275.0	1275.0	1275.0

Number of Radar tracks: 16
Number of ADS-B tracks: 6
Total number of tracks: 22

CAT062: Powerline Section 1 (East)
(500ft buffer and <1600ft MSL ~ 700ft AGL)

track_number	cntTrack_number	cntSensors	clusterSensors	clusterTarget_address	minTrack_Alt	maxTrack_Alt	avgTrack_Alt
2555	33	1	[PSR SSR]	[0009fb]	800.0	1300.0	1125.8
4031	28	1	[PSR SSR]	[000fbf]	1200.0	1300.0	1212.5
1932	13	1	[PSR SSR 1090]	[a30a7b]	1300.0	1300.0	1300.0
2417	11	1	[PSR SSR UAT]	[a1a9a4]	1275.0	1450.0	1368.2
786	10	1	[PSR SSR]	[000312]	900.0	1100.0	1012.5
1391	9	1	[PSR SSR]	[00056f]	1475.0	1550.0	1505.6
494	8	1	[PSR SSR UAT]	[a1a9a4]	925.0	1025.0	987.5
2548	8	1	[PSR SSR]	[0009f4]	500.0	750.0	671.9
1902	7	1	[PSR SSR UAT]	[aca22d]	1525.0	1550.0	1535.7
117	6	1	[PSR SSR 1090]	[a8011d]	1225.0	1275.0	1262.5
188	6	1	[PSR SSR]	[0000bc]	900.0	1000.0	920.8
1032	5	1	[PSR SSR 1090]	[a4038a]	1525.0	1525.0	1525.0
1318	5	1	[PSR SSR 1090]	[a4038a]	1150.0	1175.0	1165.0
791	5	1	[PSR SSR UAT]	[a1a9a4]	1575.0	1575.0	1575.0
1126	5	1	[PSR SSR 1090]	[a00393]	1400.0	1400.0	1400.0
3521	5	1	[PSR SSR 1090]	[a0b6eb]	1525.0	1525.0	1525.0
1842	5	1	[PSR SSR 1090]	[a0b6eb]	1525.0	1550.0	1535.0
1268	5	1	[PSR SSR]	[0004f4]	700.0	725.0	710.0
174	5	1	[PSR SSR]	[0000ae]	1325.0	1400.0	1370.0
1744	4	1	[PSR SSR]	[0006d0]	1100.0	1100.0	1100.0
2459	4	1	[PSR SSR]	[00099b]	1300.0	1300.0	1300.0
1481	4	1	[PSR SSR]	[0005c9]	1500.0	1500.0	1500.0
78	3	1	[PSR SSR UAT]	[aca22d]	1575.0	1575.0	1575.0
537	3	1	[PSR SSR]	[000219]	1400.0	1400.0	1400.0
1577	3	1	[PSR SSR]	[000629]	1175.0	1200.0	1191.7
2237	2	1	[PSR SSR]	[0008bd]	1400.0	1400.0	1400.0
2429	2	1	[PSR SSR]	[00097d]	1300.0	1300.0	1300.0
930	1	1	[PSR SSR]	[0003a2]	1500.0	1500.0	1500.0
2426	1	1	[PSR SSR]	[00097a]	1200.0	1200.0	1200.0
940	1	1	[PSR SSR]	[0003ac]	1500.0	1500.0	1500.0
2024	1	1	[PSR SSR]	[0007e8]	1275.0	1275.0	1275.0

Number of Radar tracks: 19
Number of ADS-B tracks: 12
Total number of tracks: 31
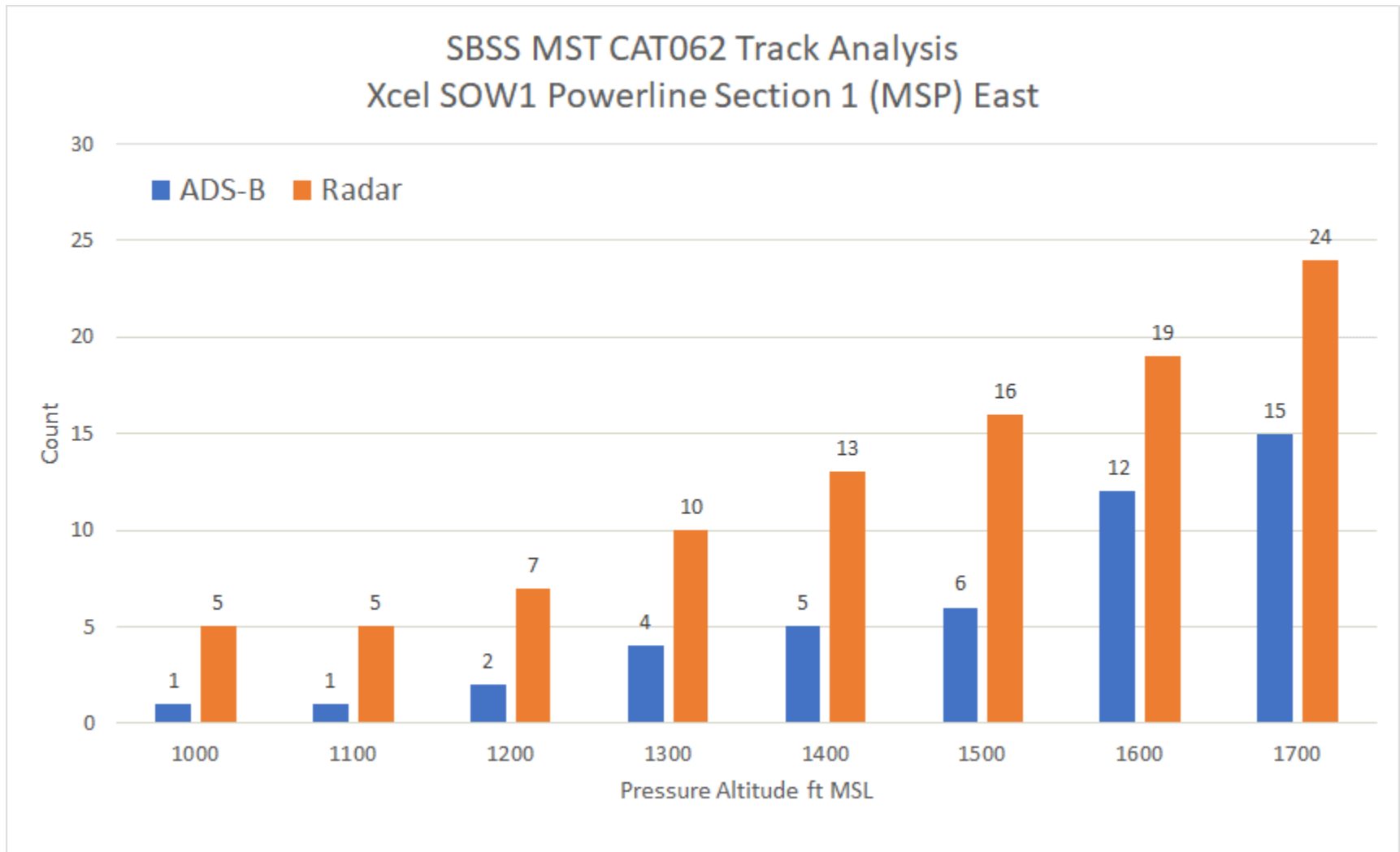
CAT062: Powerline Section 1 (East)
(500ft buffer and <1700ft MSL ~ 800ft AGL)

track_number	cntTrack_number	cntSensors	clusterSensors	clusterTarget_address	minTrack_Alt	maxTrack_Alt	avgTrack_Alt
2555	33	1	[PSR SSR]	[0009fb]	800.0	1300.0	1125.8
4031	28	1	[PSR SSR]	[000fbf]	1200.0	1300.0	1212.5
1932	13	1	[PSR SSR 1090]	[a30a7b]	1300.0	1300.0	1300.0
1391	12	1	[PSR SSR]	[00056f]	1475.0	1600.0	1529.2
2417	11	1	[PSR SSR UAT]	[a1a9a4]	1275.0	1450.0	1368.2
485	10	1	[PSR SSR UAT]	[a84bc8]	1625.0	1675.0	1657.5
786	10	1	[PSR SSR]	[000312]	900.0	1100.0	1012.5
494	8	1	[PSR SSR UAT]	[a1a9a4]	925.0	1025.0	987.5
2548	8	1	[PSR SSR]	[0009f4]	500.0	750.0	671.9
108	7	1	[PSR SSR]	[00006c]	1600.0	1600.0	1600.0
1902	7	1	[PSR SSR UAT]	[aca22d]	1525.0	1550.0	1535.7
3695	7	1	[PSR SSR 1090]	[a6226c]	1600.0	1675.0	1625.0
117	6	1	[PSR SSR 1090]	[a8011d]	1225.0	1275.0	1262.5
2258	6	1	[PSR SSR]	[0008d2]	1600.0	1600.0	1600.0
188	6	1	[PSR SSR]	[0000bc]	900.0	1000.0	920.8
78	5	1	[PSR SSR UAT]	[aca22d]	1575.0	1600.0	1585.0
1032	5	1	[PSR SSR 1090]	[a4038a]	1525.0	1525.0	1525.0
1318	5	1	[PSR SSR 1090]	[a4038a]	1150.0	1175.0	1165.0
791	5	1	[PSR SSR UAT]	[a1a9a4]	1575.0	1575.0	1575.0
1126	5	1	[PSR SSR 1090]	[a00393]	1400.0	1400.0	1400.0
3521	5	1	[PSR SSR 1090]	[a0b6eb]	1525.0	1525.0	1525.0
1842	5	1	[PSR SSR 1090]	[a0b6eb]	1525.0	1550.0	1535.0
1268	5	1	[PSR SSR]	[0004f4]	700.0	725.0	710.0
174	5	1	[PSR SSR]	[0000ae]	1325.0	1400.0	1370.0
1770	4	1	[PSR SSR]	[0006ea]	1600.0	1600.0	1600.0
1744	4	1	[PSR SSR]	[0006d0]	1100.0	1100.0	1100.0
2459	4	1	[PSR SSR]	[00099b]	1300.0	1300.0	1300.0
1481	4	1	[PSR SSR]	[0005c9]	1500.0	1500.0	1500.0
984	3	1	[PSR SSR]	[0003d8]	1600.0	1600.0	1600.0
537	3	1	[PSR SSR]	[000219]	1400.0	1400.0	1400.0
1577	3	1	[PSR SSR]	[000629]	1175.0	1200.0	1191.7
2237	2	1	[PSR SSR]	[0008bd]	1400.0	1400.0	1400.0
2429	2	1	[PSR SSR]	[00097d]	1300.0	1300.0	1300.0
119	2	1	[PSR SSR]	[000077]	1600.0	1600.0	1600.0
505	1	1	[PSR SSR 1090]	[acad43]	1675.0	1675.0	1675.0
930	1	1	[PSR SSR]	[0003a2]	1500.0	1500.0	1500.0
2426	1	1	[PSR SSR]	[00097a]	1200.0	1200.0	1200.0
940	1	1	[PSR SSR]	[0003ac]	1500.0	1500.0	1500.0
2024	1	1	[PSR SSR]	[0007e8]	1275.0	1275.0	1275.0

Number of Radar tracks: 24
Number of ADS-B tracks: 15
Total number of tracks: 39

CAT062: Powerline Section 1 (East) 500ft buffer

SBSS MST CAT062 Track Analysis
Xcel SOW1 Powerline Section 1 (MSP) East

Pressure Altitude ft MSL	ADS-B	Radar
1000	1	5
1100	1	5
1200	2	7
1300	4	10
1400	5	13
1500	6	16
1600	12	19
1700	15	24

CAT062: Powerline Section 1 (West)
(500ft buffer and <1000ft MSL ~ 100ft AGL)

track_number	cntTrack_number	cntSensors	clusterSensors	clusterTarget_address	minTrack_Alt	maxTrack_Alt	avgTrack_Alt
1042	13	1	[PSR SSR UAT]	[a1a9a4]	700.0	950.0	857.7
2193	4	1	[PSR SSR]	[000891]	900.0	900.0	900.0
3074	3	1	[PSR SSR]	[000c02]	175.0	200.0	183.3
3532	1	1	[PSR SSR]	[000dcc]	950.0	950.0	950.0

Number of Radar tracks: 4
Number of ADS-B tracks: 1
Total number of tracks: 5

CAT062: Powerline Section 1 (West)
(500ft buffer and <1100ft MSL ~ 200ft AGL)

track_number	cntTrack_number	cntSensors	clusterSensors	clusterTarget_address	minTrack_Alt	maxTrack_Alt	avgTrack_Alt
1042	13	1	[PSR SSR UAT]	[a1a9a4]	700.0	950.0	857.7
2193	4	1	[PSR SSR]	[000891]	900.0	900.0	900.0
3074	3	1	[PSR SSR]	[000c02]	175.0	200.0	183.3
3532	1	1	[PSR SSR]	[000dcc]	950.0	950.0	950.0

Number of Radar tracks: 4
Number of ADS-B tracks: 1
Total number of tracks: 5

CAT062: Powerline Section 1 (West)
(500ft buffer and <1200ft MSL ~ 300ft AGL)

track_number	cntTrack_number	cntSensors	clusterSensors	clusterTarget_address	minTrack_Alt	maxTrack_Alt	avgTrack_Alt
1042	13	1	[PSR SSR UAT]	[a1a9a4]	700.0	950.0	857.7
46	7	1	[PSR SSR 1090]	[a76b63]	1100.0	1100.0	1100.0
2193	4	1	[PSR SSR]	[000891]	900.0	900.0	900.0
3074	3	1	[PSR SSR]	[000c02]	175.0	200.0	183.3
1282	3	1	[PSR SSR]	[000502]	1100.0	1100.0	1100.0
3532	3	1	[PSR SSR]	[000dcc]	950.0	1000.0	983.3
4031	1	1	[PSR SSR]	[000fbf]	1175.0	1175.0	1175.0

Number of Radar tracks: 5
Number of ADS-B tracks: 2
Total number of tracks: 7

CAT062: Powerline Section 1 (West)
(500ft buffer and <1300ft MSL ~ 400ft AGL)

track_number	cntTrack_number	cntSensors	clusterSensors	clusterTarget_address	minTrack_Alt	maxTrack_Alt	avgTrack_Alt
1042	13	1	[PSR SSR UAT]	[a1a9a4]	700.0	950.0	857.7
4031	11	2	[PSR SSR, SSR]	[000fbf]	1175.0	1275.0	1220.5
46	7	1	[PSR SSR 1090]	[a76b63]	1100.0	1100.0	1100.0
2193	4	1	[PSR SSR]	[000891]	900.0	900.0	900.0
3074	3	1	[PSR SSR]	[000c02]	175.0	200.0	183.3
1282	3	1	[PSR SSR]	[000502]	1100.0	1100.0	1100.0
3532	3	1	[PSR SSR]	[000dcc]	950.0	1000.0	983.3
2430	2	1	[PSR SSR]	[00097e]	1275.0	1275.0	1275.0

Number of Radar tracks: 6
Number of ADS-B tracks: 2
Total number of tracks: 8

CAT062: Powerline Section 1 (West)
(500ft buffer and <1400ft MSL ~ 500ft AGL)

track_number	cntTrack_number	cntSensors	clusterSensors	clusterTarget_address	minTrack_Alt	maxTrack_Alt	avgTrack_Alt
4031	39	2	[PSR SSR, SSR]	[000fbf]	1175.0	1375.0	1279.5
1042	13	1	[PSR SSR UAT]	[a1a9a4]	700.0	950.0	857.7
2464	12	1	[PSR SSR 1090]	[a76b63]	1300.0	1300.0	1300.0
2772	9	1	[PSR SSR 1090]	[ad3cdd]	1300.0	1375.0	1330.6
897	7	1	[PSR SSR 1090]	[a221c6]	1325.0	1325.0	1325.0
46	7	1	[PSR SSR 1090]	[a76b63]	1100.0	1100.0	1100.0
2193	4	1	[PSR SSR]	[000891]	900.0	900.0	900.0
3074	3	1	[PSR SSR]	[000c02]	175.0	200.0	183.3
1282	3	1	[PSR SSR]	[000502]	1100.0	1100.0	1100.0
3532	3	1	[PSR SSR]	[000dcc]	950.0	1000.0	983.3
2430	3	1	[PSR SSR]	[00097e]	1275.0	1300.0	1283.3
3535	3	1	[PSR SSR 1090]	[a724b2]	1375.0	1375.0	1375.0
1847	2	1	[PSR SSR]	[000737]	1300.0	1300.0	1300.0

Number of Radar tracks: 7
Number of ADS-B tracks: 6
Total number of tracks: 13

CAT062: Powerline Section 1 (West)
(500ft buffer and <1500ft MSL ~ 600ft AGL)

track_number	cntTrack_number	cntSensors	clusterSensors	clusterTarget_address	minTrack_Alt	maxTrack_Alt	avgTrack_Alt
4031	43	2	[PSR SSR, SSR]	[000fbf]	1175.0	1400.0	1290.7
2772	16	1	[PSR SSR 1090]	[ad3cdd]	1300.0	1475.0	1375.0
3535	16	1	[PSR SSR 1090]	[a724b2]	1375.0	1425.0	1396.9
1042	13	1	[PSR SSR UAT]	[a1a9a4]	700.0	950.0	857.7
2464	12	1	[PSR SSR 1090]	[a76b63]	1300.0	1300.0	1300.0
897	7	1	[PSR SSR 1090]	[a221c6]	1325.0	1325.0	1325.0
46	7	1	[PSR SSR 1090]	[a76b63]	1100.0	1100.0	1100.0
647	5	1	[PSR SSR UAT]	[a2f087]	1475.0	1475.0	1475.0
2903	5	1	[PSR SSR 1090]	[a00393]	1400.0	1400.0	1400.0
32	5	1	[PSR SSR 1090]	[a00393]	1425.0	1450.0	1435.0
2193	4	1	[PSR SSR]	[000891]	900.0	900.0	900.0
1003	4	1	[PSR SSR 1090]	[a00393]	1400.0	1400.0	1400.0
2430	4	1	[PSR SSR]	[00097e]	1275.0	1400.0	1312.5
3074	3	1	[PSR SSR]	[000c02]	175.0	200.0	183.3
1282	3	1	[PSR SSR]	[000502]	1100.0	1100.0	1100.0
3532	3	1	[PSR SSR]	[000dcc]	950.0	1000.0	983.3
1847	2	1	[PSR SSR]	[000737]	1300.0	1300.0	1300.0
1930	2	1	[PSR SSR]	[00078a]	1400.0	1400.0	1400.0

Number of Radar tracks: 8
Number of ADS-B tracks: 10
Total number of tracks: 18
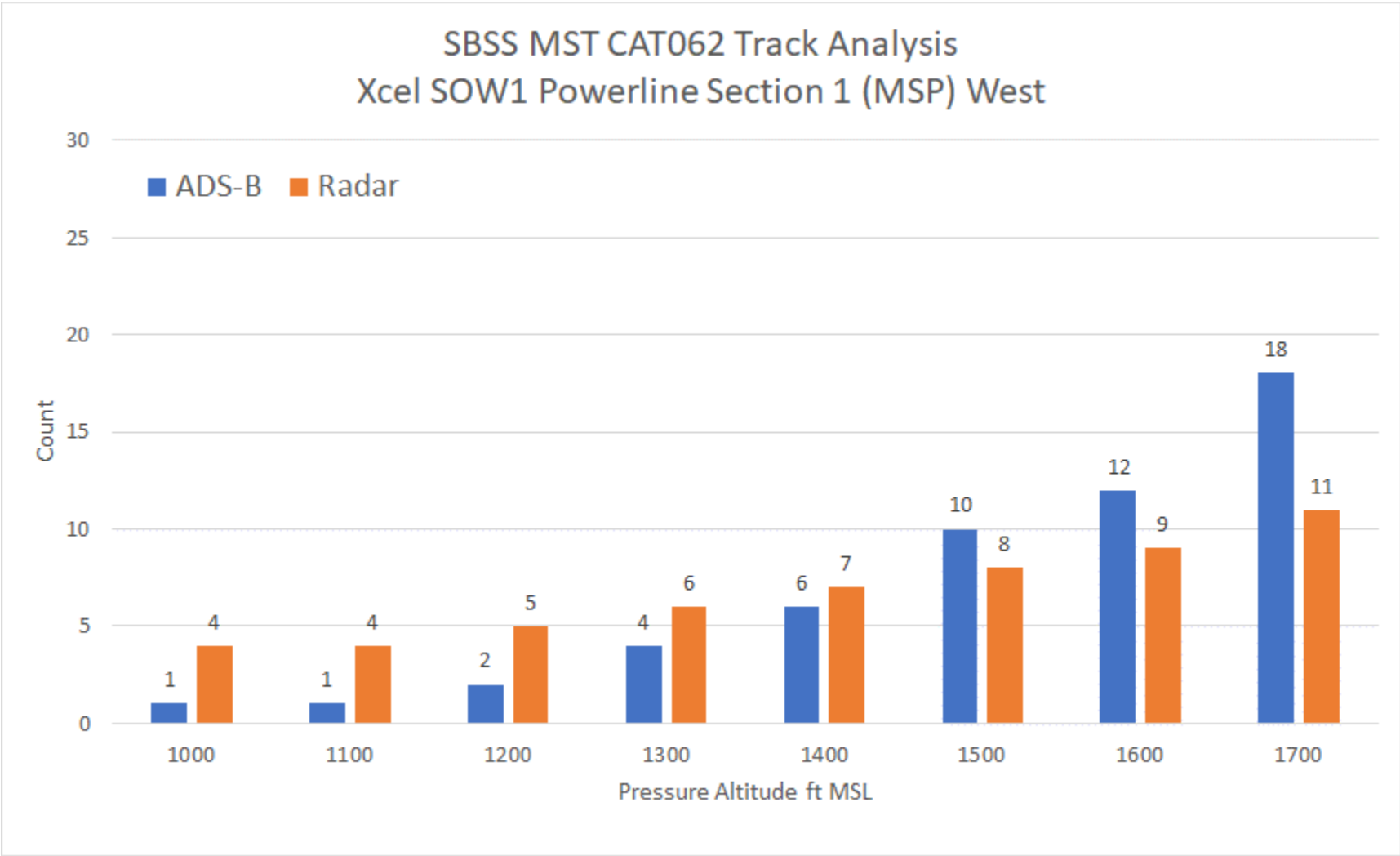
CAT062: Powerline Section 1 (West)
(500ft buffer and <1600ft MSL ~ 700ft AGL)

track_number	cntTrack_number	cntSensors	clusterSensors	clusterTarget_address	minTrack_Alt	maxTrack_Alt	avgTrack_Alt
4031	43	2	[PSR SSR, SSR]	[000fbf]	1175.0	1400.0	1290.7
3535	24	1	[PSR SSR 1090]	[a724b2]	1375.0	1500.0	1431.3
2772	17	1	[PSR SSR 1090]	[ad3cdd]	1300.0	1500.0	1382.4
1042	13	1	[PSR SSR UAT]	[a1a9a4]	700.0	950.0	857.7
2464	12	1	[PSR SSR 1090]	[a76b63]	1300.0	1300.0	1300.0
2929	9	1	[PSR SSR 1090]	[a724b2]	1500.0	1500.0	1500.0
897	7	1	[PSR SSR 1090]	[a221c6]	1325.0	1325.0	1325.0
613	7	1	[PSR SSR 1090]	[a131d5]	1500.0	1550.0	1521.4
46	7	1	[PSR SSR 1090]	[a76b63]	1100.0	1100.0	1100.0
647	5	1	[PSR SSR UAT]	[a2f087]	1475.0	1475.0	1475.0
2903	5	1	[PSR SSR 1090]	[a00393]	1400.0	1400.0	1400.0
32	5	1	[PSR SSR 1090]	[a00393]	1425.0	1450.0	1435.0
2193	4	1	[PSR SSR]	[000891]	900.0	900.0	900.0
1003	4	1	[PSR SSR 1090]	[a00393]	1400.0	1400.0	1400.0
2430	4	1	[PSR SSR]	[00097e]	1275.0	1400.0	1312.5
1862	4	1	[PSR SSR]	[000746]	1500.0	1550.0	1512.5
3074	3	1	[PSR SSR]	[000c02]	175.0	200.0	183.3
1282	3	1	[PSR SSR]	[000502]	1100.0	1100.0	1100.0
3532	3	1	[PSR SSR]	[000dcc]	950.0	1000.0	983.3
1847	2	1	[PSR SSR]	[000737]	1300.0	1300.0	1300.0
1930	2	1	[PSR SSR]	[00078a]	1400.0	1400.0	1400.0

Number of Radar tracks: 9
Number of ADS-B tracks: 12
Total number of tracks: 21

CAT062: Powerline Section 1 (West)
(500ft buffer and <1700ft MSL ~ 800ft AGL)

track_number	cntTrack_number	cntSensors	clusterSensors	clusterTarget_address	minTrack_Alt	maxTrack_Alt	avgTrack_Alt
4031	43	2	[PSR SSR, SSR]	[000fbf]	1175.0	1400.0	1290.7
3535	24	1	[PSR SSR 1090]	[a724b2]	1375.0	1500.0	1431.3
2772	17	1	[PSR SSR 1090]	[ad3cdd]	1300.0	1500.0	1382.4
1042	13	1	[PSR SSR UAT]	[a1a9a4]	700.0	950.0	857.7
2464	12	1	[PSR SSR 1090]	[a76b63]	1300.0	1300.0	1300.0
2929	9	1	[PSR SSR 1090]	[a724b2]	1500.0	1500.0	1500.0
897	7	1	[PSR SSR 1090]	[a221c6]	1325.0	1325.0	1325.0
613	7	1	[PSR SSR 1090]	[a131d5]	1500.0	1550.0	1521.4
46	7	1	[PSR SSR 1090]	[a76b63]	1100.0	1100.0	1100.0
3819	6	1	[PSR SSR 1090]	[a00393]	1600.0	1600.0	1600.0
647	5	1	[PSR SSR UAT]	[a2f087]	1475.0	1475.0	1475.0
2903	5	1	[PSR SSR 1090]	[a00393]	1400.0	1400.0	1400.0
32	5	1	[PSR SSR 1090]	[a00393]	1425.0	1450.0	1435.0
1862	5	1	[PSR SSR]	[000746]	1500.0	1600.0	1530.0
2193	4	1	[PSR SSR]	[000891]	900.0	900.0	900.0
3414	4	1	[PSR SSR UAT]	[a2f087]	1600.0	1625.0	1618.8
1003	4	1	[PSR SSR 1090]	[a00393]	1400.0	1400.0	1400.0
2430	4	1	[PSR SSR]	[00097e]	1275.0	1400.0	1312.5
3074	3	1	[PSR SSR]	[000c02]	175.0	200.0	183.3
2426	3	1	[PSR SSR 1090]	[ad2d40]	1625.0	1625.0	1625.0
1282	3	1	[PSR SSR]	[000502]	1100.0	1100.0	1100.0
3532	3	1	[PSR SSR]	[000dcc]	950.0	1000.0	983.3
460	2	1	[PSR SSR 1090]	[a00393]	1600.0	1675.0	1637.5
1847	2	1	[PSR SSR]	[000737]	1300.0	1300.0	1300.0
1930	2	1	[PSR SSR]	[00078a]	1400.0	1400.0	1400.0
810	2	1	[PSR SSR]	[00032a]	1600.0	1600.0	1600.0
90	2	1	[PSR SSR 1090]	[a989fe]	1675.0	1675.0	1675.0
3198	1	1	[PSR SSR]	[000c7e]	1600.0	1600.0	1600.0
2912	1	1	[PSR SSR 1090]	[a00393]	1675.0	1675.0	1675.0

Number of Radar tracks: 11
Number of ADS-B tracks: 18
Total number of tracks: 29

CAT062: Powerline Section 1 (West) 500ft buffer

SBSS MST CAT062 Track Analysis
Xcel SOW1 Powerline Section 1 (MSP) West

CAT062: Powerline Section 1 (Airlake)
(500ft buffer and <1000ft MSL ~ 100ft AGL)

track_number	cntTrack_number	cntSensors	clusterSensors	clusterTarget_address	minTrack_Alt	maxTrack_Alt	avgTrack_Alt
1847	17	1	[PSR SSR]	[000737]	275.0	425.0	400.0
2548	4	1	[PSR SSR]	[0009f4]	500.0	600.0	550.0
3151	3	1	[PSR SSR]	[000c4f]	975.0	975.0	975.0
786	3	1	[PSR SSR]	[000312]	900.0	900.0	900.0
2592	2	1	[PSR SSR UAT]	[aca4f4]	925.0	950.0	937.5
1811	1	1	[PSR SSR]	[000713]	500.0	500.0	500.0
3935	1	1	[PSR SSR]	[aca4f4]	75.0	75.0	75.0
188	1	1	[PSR SSR]	[0000bc]	900.0	900.0	900.0

Number of Radar tracks: 7
Number of ADS-B tracks: 1
Total number of tracks: 8

CAT062: Powerline Section 1 (Airlake)
(500ft buffer and <1100ft MSL ~ 200ft AGL)

track_number	cntTrack_number	cntSensors	clusterSensors	clusterTarget_address	minTrack_Alt	maxTrack_Alt	avgTrack_Alt
1847	17	1	[PSR SSR]	[000737]	275.0	425.0	400.0
3626	6	1	[PSR SSR]	[000e2a]	1075.0	1075.0	1075.0
786	6	1	[PSR SSR]	[000312]	900.0	1000.0	950.0
188	4	1	[PSR SSR]	[0000bc]	900.0	1000.0	975.0
2548	4	1	[PSR SSR]	[0009f4]	500.0	600.0	550.0
3151	3	1	[PSR SSR]	[000c4f]	975.0	975.0	975.0
2592	3	1	[PSR SSR UAT]	[aca4f4]	925.0	1000.0	958.3
1811	1	1	[PSR SSR]	[000713]	500.0	500.0	500.0
3074	1	1	[PSR SSR]	[000c02]	1075.0	1075.0	1075.0
3935	1	1	[PSR SSR]	[aca4f4]	75.0	75.0	75.0

Number of Radar tracks: 9
Number of ADS-B tracks: 1
Total number of tracks: 10

CAT062: Powerline Section 1 (Airlake)
(500ft buffer and <1200ft MSL ~ 300ft AGL)

track_number	cntTrack_number	cntSensors	clusterSensors	clusterTarget_address	minTrack_Alt	maxTrack_Alt	avgTrack_Alt
1847	17	1	[PSR SSR]	[000737]	275.0	425.0	400.0
1983	9	1	[PSR SSR 1090]	[a47070]	1100.0	1125.0	1119.4
3626	8	1	[PSR SSR]	[000e2a]	1075.0	1125.0	1084.4
786	7	1	[PSR SSR]	[000312]	900.0	1100.0	971.4
276	7	1	[PSR SSR 1090]	[a30a7b]	1100.0	1100.0	1100.0
3074	4	1	[PSR SSR]	[000c02]	1075.0	1150.0	1106.3
3079	4	1	[PSR SSR]	[000c07]	1100.0	1125.0	1106.3
188	4	1	[PSR SSR]	[0000bc]	900.0	1000.0	975.0
2548	4	1	[PSR SSR]	[0009f4]	500.0	600.0	550.0
3151	3	1	[PSR SSR]	[000c4f]	975.0	975.0	975.0
715	3	1	[PSR SSR 1090]	[a47070]	1125.0	1175.0	1150.0
2592	3	1	[PSR SSR UAT]	[aca4f4]	925.0	1000.0	958.3
1811	1	1	[PSR SSR]	[000713]	500.0	500.0	500.0
3935	1	1	[PSR SSR]	[aca4f4]	75.0	75.0	75.0

Number of Radar tracks: 10
Number of ADS-B tracks: 4
Total number of tracks: 14

CAT062: Powerline Section 1 (Airlake)
(500ft buffer and <1300ft MSL ~ 400ft AGL)

track_number	cntTrack_number	cntSensors	clusterSensors	clusterTarget_address	minTrack_Alt	maxTrack_Alt	avgTrack_Alt
1847	17	1	[PSR SSR]	[000737]	275.0	425.0	400.0
3074	11	1	[PSR SSR]	[000c02]	1075.0	1200.0	1165.9
3626	10	1	[PSR SSR]	[000e2a]	1075.0	1250.0	1115.0
494	9	1	[PSR SSR UAT]	[a1a9a4]	1200.0	1200.0	1200.0
1983	9	1	[PSR SSR 1090]	[a47070]	1100.0	1125.0	1119.4
786	8	1	[PSR SSR]	[000312]	900.0	1200.0	1000.0
3151	7	1	[PSR SSR]	[000c4f]	975.0	1275.0	1132.1
276	7	1	[PSR SSR 1090]	[a30a7b]	1100.0	1100.0	1100.0
715	6	1	[PSR SSR 1090]	[a47070]	1125.0	1200.0	1175.0
2205	4	1	[PSR SSR]	[00089d]	1200.0	1275.0	1250.0
3079	4	1	[PSR SSR]	[000c07]	1100.0	1125.0	1106.3
188	4	1	[PSR SSR]	[0000bc]	900.0	1000.0	975.0
4031	4	1	[PSR SSR]	[000fbf]	1200.0	1275.0	1231.3
2548	4	1	[PSR SSR]	[0009f4]	500.0	600.0	550.0
2189	3	1	[PSR SSR]	[00088d]	1225.0	1275.0	1258.3
197	3	1	[PSR SSR]	[0000c5]	1200.0	1275.0	1250.0
2592	3	1	[PSR SSR UAT]	[aca4f4]	925.0	1000.0	958.3
458	2	1	[PSR SSR]	[0001ca]	1275.0	1275.0	1275.0
3783	1	1	[PSR SSR]	[000ec7]	1250.0	1250.0	1250.0
3978	1	1	[PSR SSR]	[000f8a]	1225.0	1225.0	1225.0
1811	1	1	[PSR SSR]	[000713]	500.0	500.0	500.0
2440	1	1	[PSR SSR]	[000988]	1200.0	1200.0	1200.0
3935	1	1	[PSR SSR]	[aca4f4]	75.0	75.0	75.0
2426	1	1	[PSR SSR]	[00097a]	1200.0	1200.0	1200.0
2487	1	1	[PSR SSR]	[0009b7]	1200.0	1200.0	1200.0

Number of Radar tracks: 20
Number of ADS-B tracks: 5
Total number of tracks: 25

CAT062: Powerline Section 1 (Airlake)
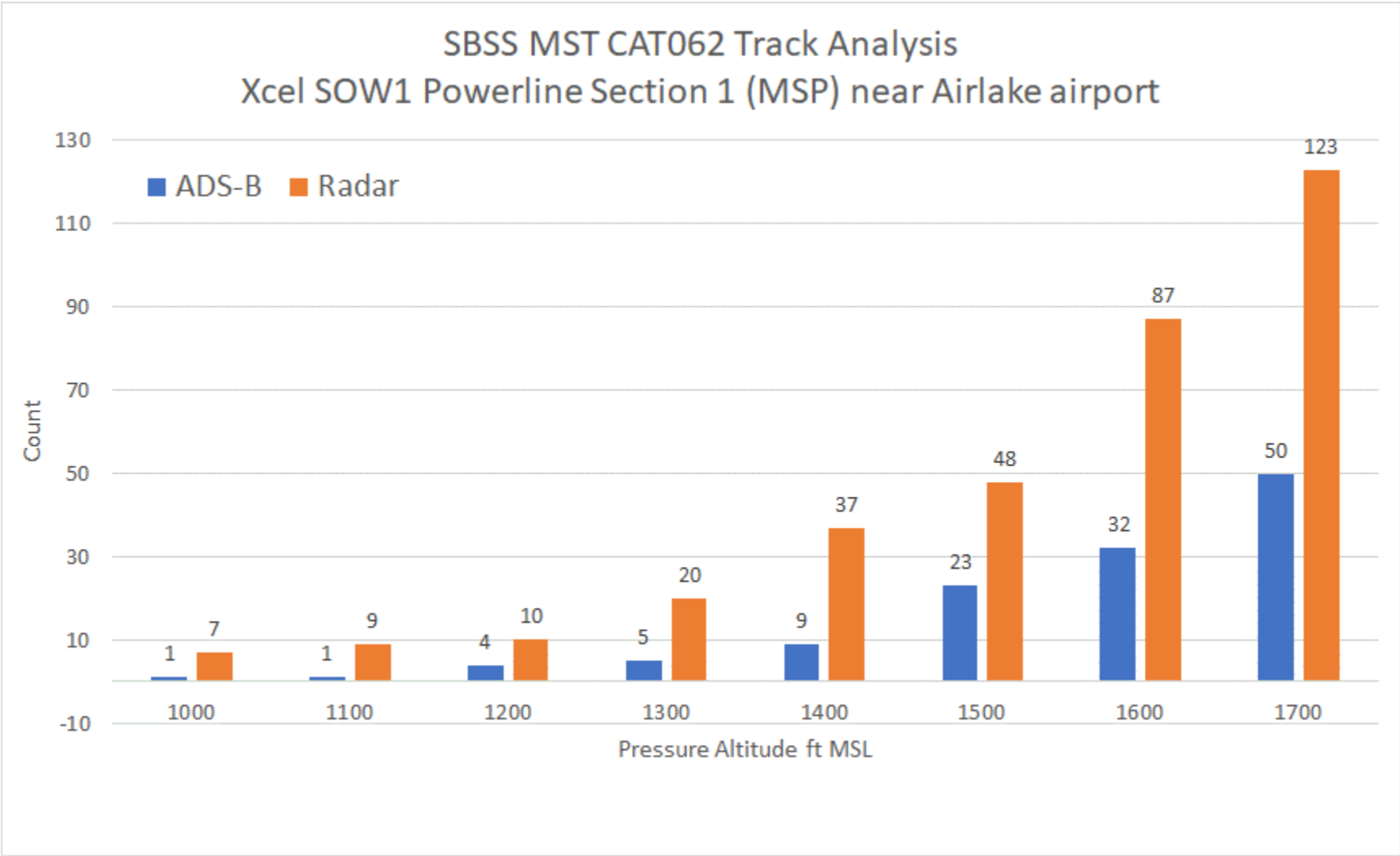## (500ft buffer and <1400ft MSL ~ 500ft AGL)

To many to list

Number of Radar tracks: 37
Number of ADS-B tracks: 9
Total number of tracks: 46

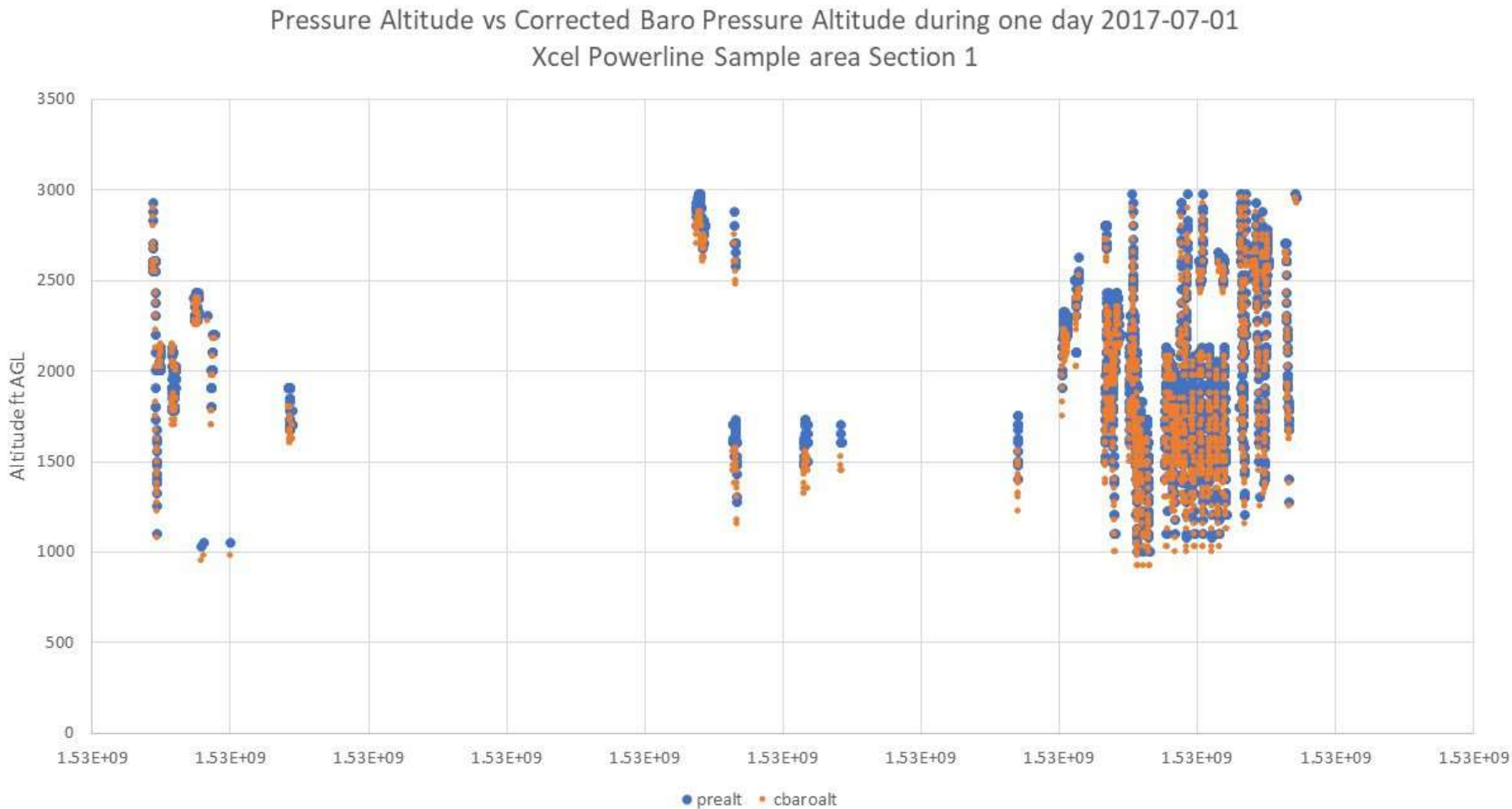# CAT062: Powerline Section 1 (Airlake)
(500ft buffer and <1500ft MSL ~ 600ft AGL)

To many to list

Number of Radar tracks: 48
Number of ADS-B tracks: 23
Total number of tracks: 71

CAT062: Powerline Section 1 (Airlake)
(500ft buffer and <1600ft MSL ~ 700ft AGL)

To many to list

Number of Radar tracks: 87
Number of ADS-B tracks: 32
Total number of tracks: 119

To many to list

Number of Radar tracks: 123
Number of ADS-B tracks: 50
Total number of tracks: 173

SBSS MST CAT062 Track Analysis
Xcel SOW1 Powerline Section 1 (MSP) near Airlake airport

SBSS MST CAT062 Track Analysis 500ft buffer
Xcel SOW1 Powerline Section 1 (MSP)

Pressure Altitude vs Corrected Baro Pressure Altitude during one day 2017-07-01
Xcel Powerline Sample area Section 1

Pressure Alt vs Corrected Baro Alt: 1 July 2018

Pressure vs Corrected Baro Pressure Altitude difference during 2017-07-01
Xcel Powerline Sample area Section 1
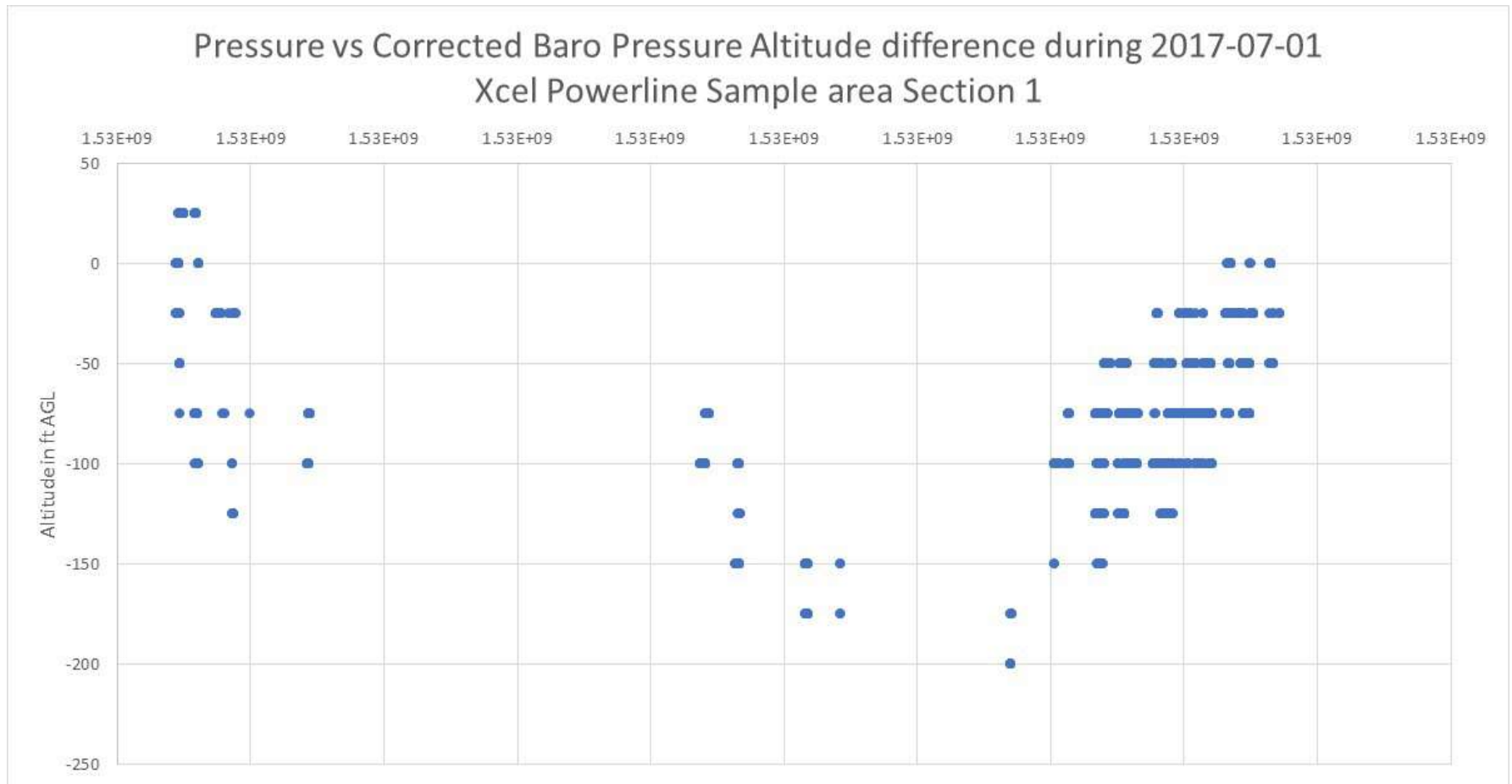
Average: -73 feet
Std: 41 feet

Pressure Hg: Airlake (KLVN) 1-7 July 2018
VAS Data with Corrected Baro Altitude (2000ft buffer)
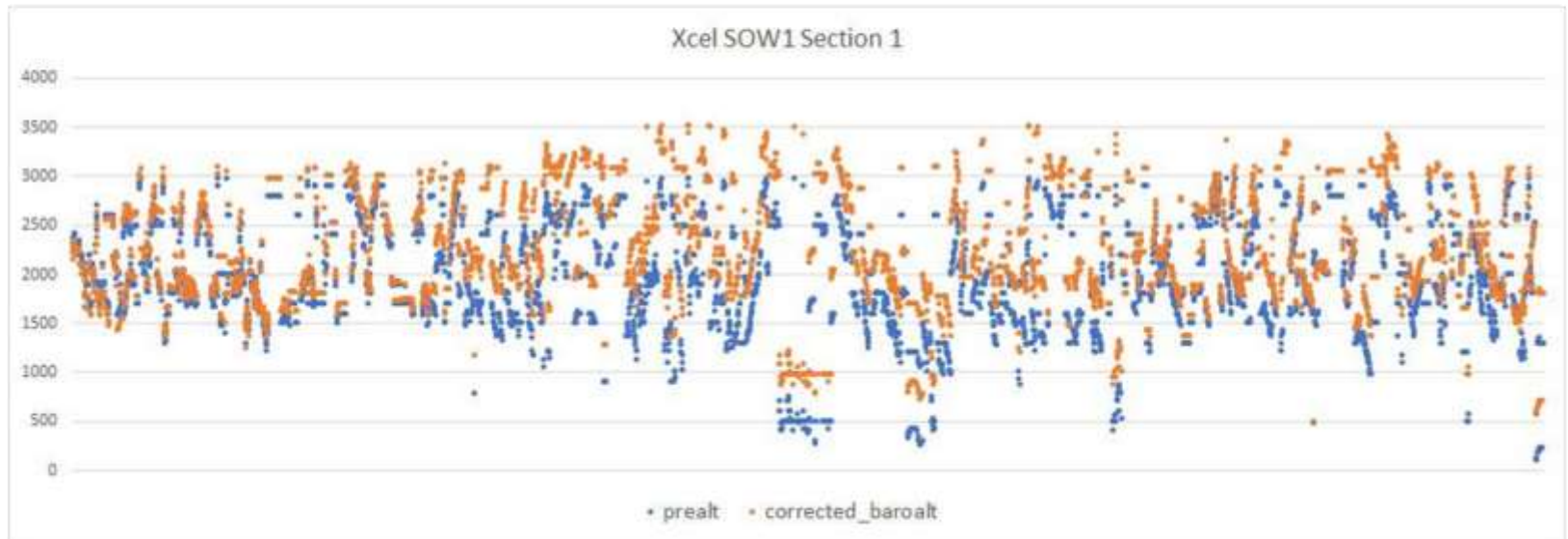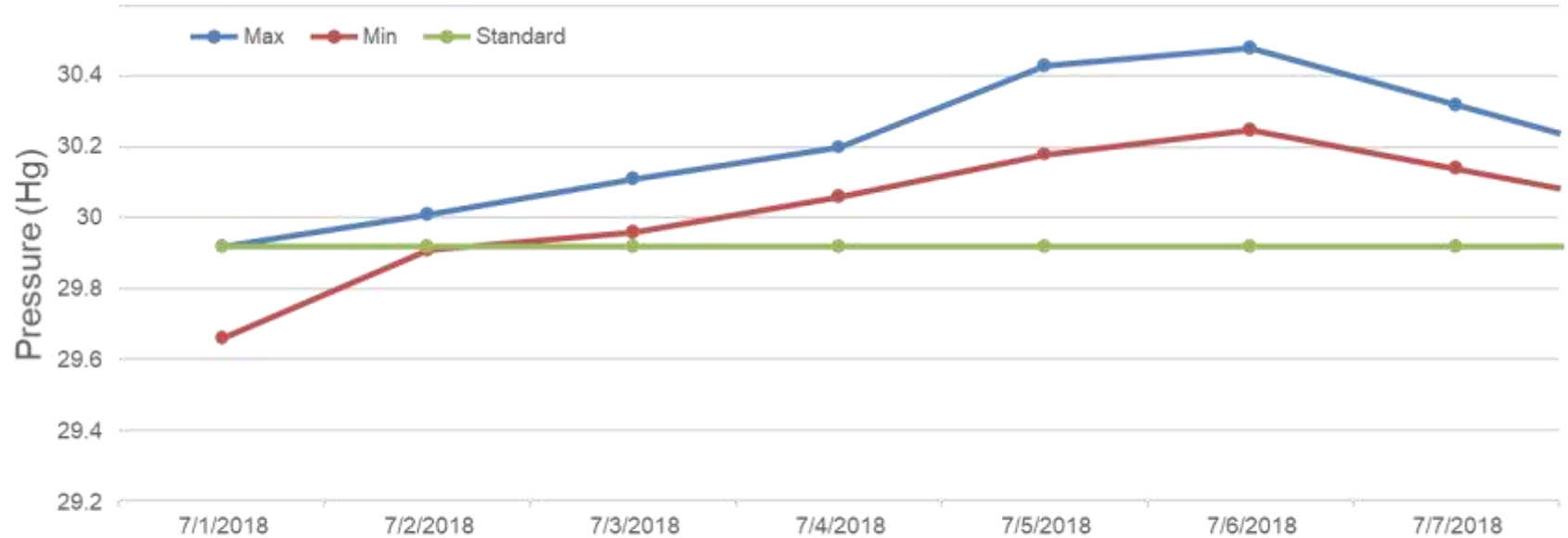
P(LWC) Analysis Powerline Section 1 (West)
(MST-CAT062: 2000ft buffer and <1300ft MSL ~ 400ft AGL)

P(LWC – loss of well clear) = P(UAS present)*P(UAS 2000ft)*P(TOO)

- P(UAS present) = Drone flight durations / 2 weeks (TOO analysis)
  - P(UAS present) = 24hrs / 336hrs = **7.14E-02**
- P(UAS 2000ft) = Area(UAS 2000ft) / Area(Powerline 2000ft)

  Note: Area Powerline 2000ft has a ceiling of 1300ftMSL (~400ftAGL) inclusive of the vertical drone separation buffer of ~200ft assuming drone flight altitude is 200ftAGL

  - P(UAS 2000ft) = 0.4479sq mi / 16.88 sq mi = **2.65E-02**

P(LWC) Analysis Powerline Section 1 (West)
(MST-CAT062: 2000ft buffer and <1300ft MSL ~ 400ft AGL)

P(TOO) = TOO flight durations within PL buffer / 2 weeks (TOO analysis)
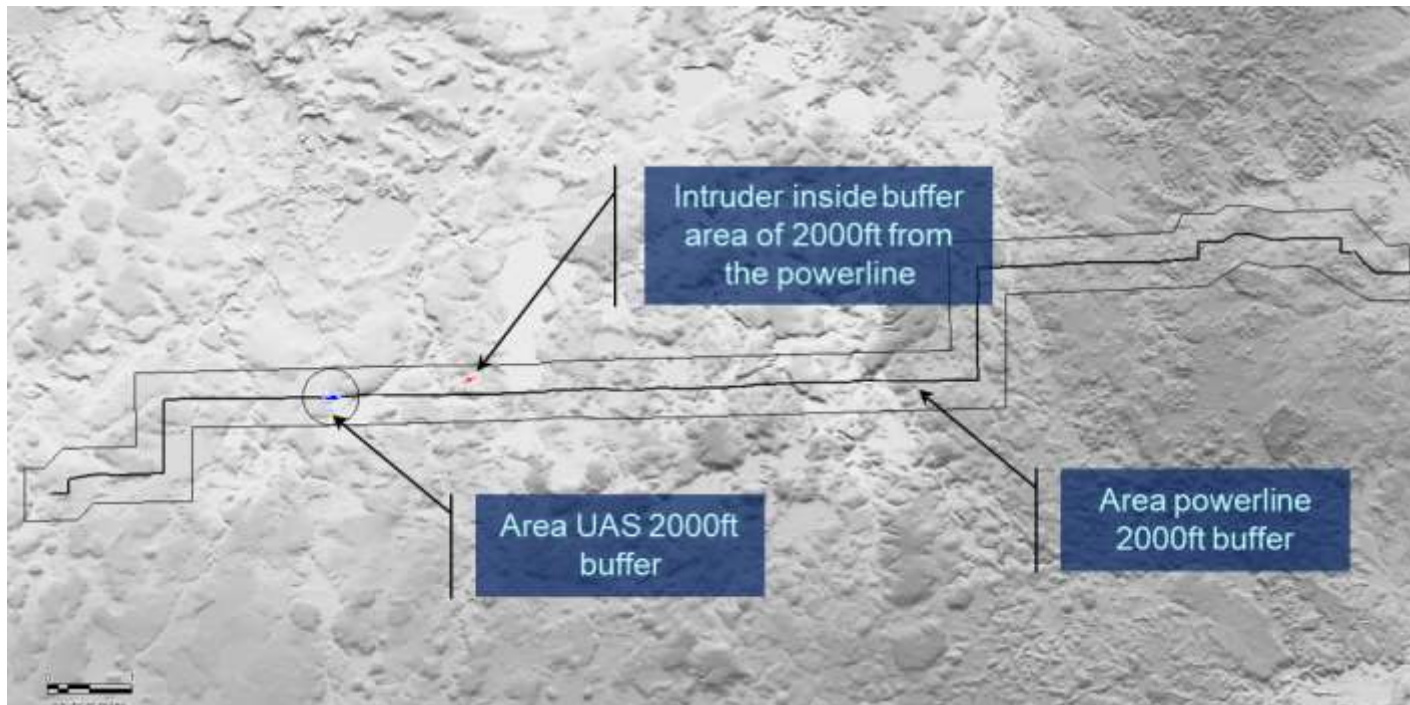
P(LWC) Analysis Powerline Section 1 (West)
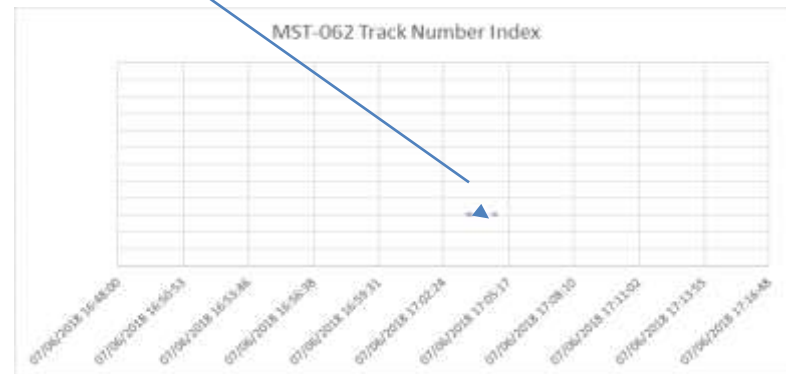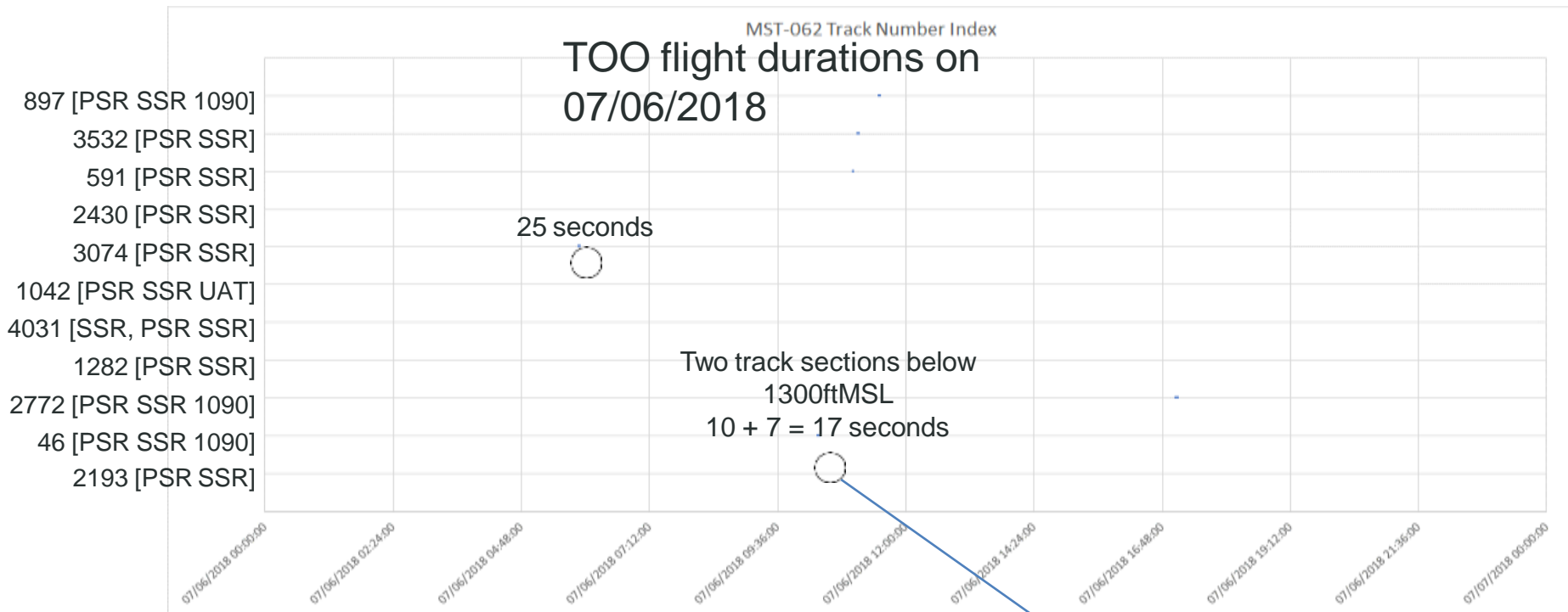## TOO Flight Durations on 07/01/2018 – 07/14/2018

Assumption:

- TOOs within 2000ft buffer of powerline are unique events
- Uniform distribution of flights over time
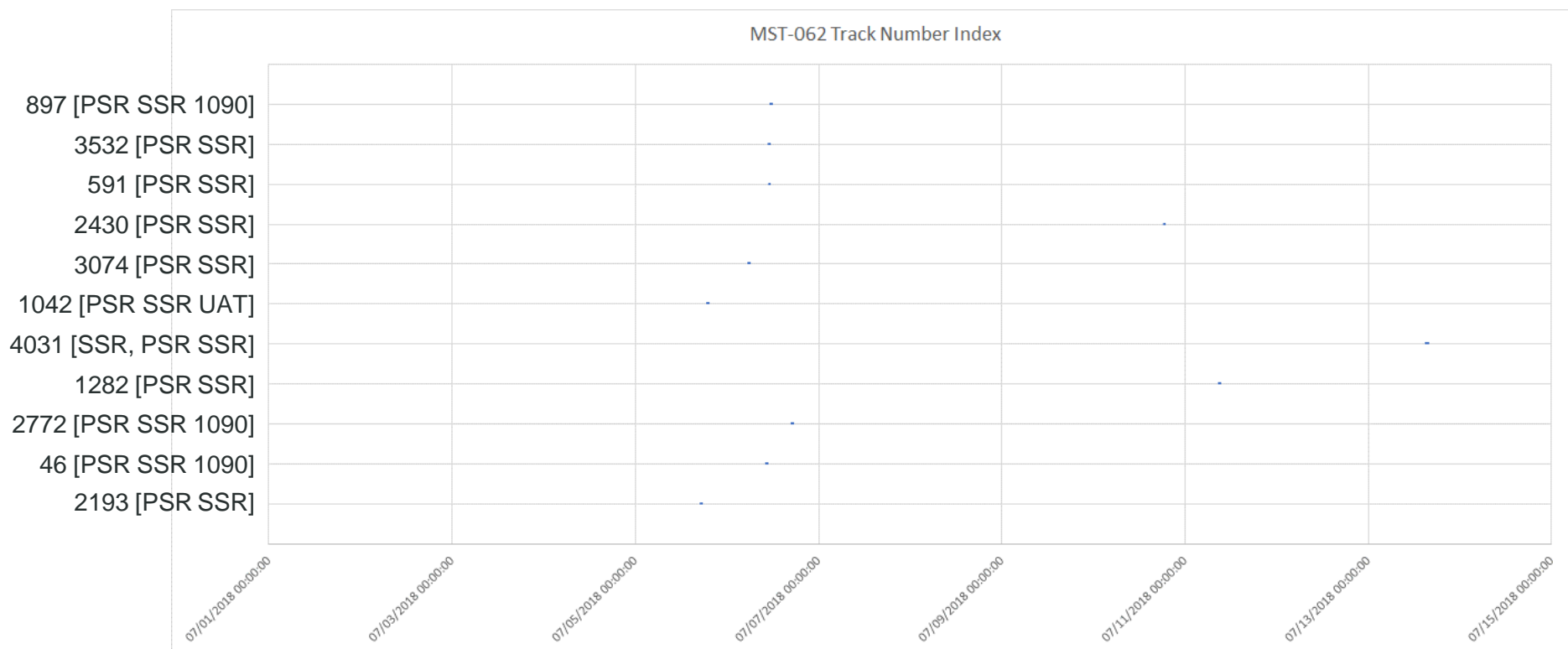
TOO flight durations 07/01/2018 – 07/14/2018

P(LWC) Analysis Powerline Section 1 (West)
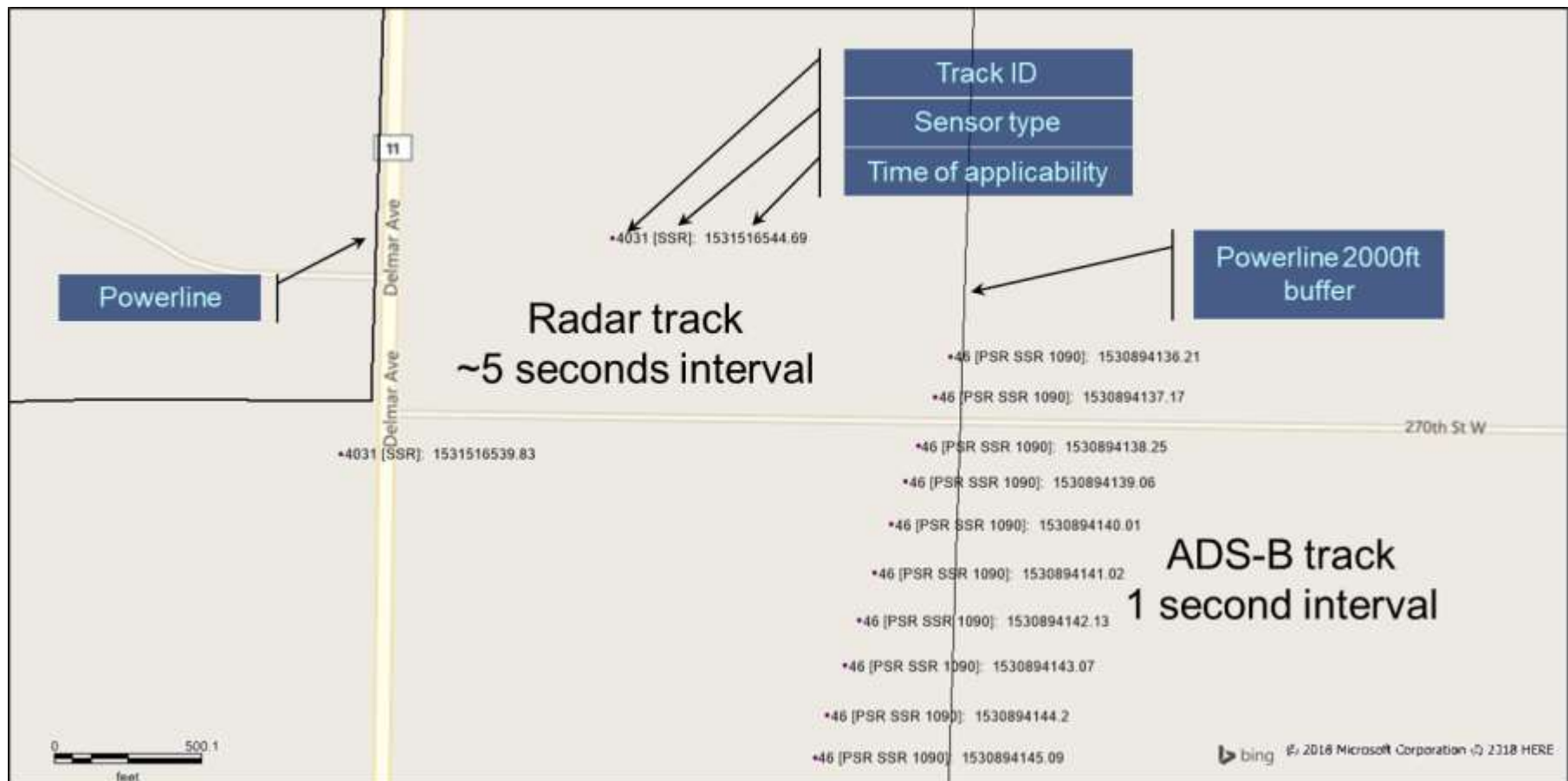## Example TOO Flight Durations on 07/06/2018

MST-062 Track Number Index

TOO flight durations on 07/06/2018

897 [PSR SSR 1090]
3532 [PSR SSR]
591 [PSR SSR]
2430 [PSR SSR]
3074 [PSR SSR]
1042 [PSR SSR UAT]
4031 [SSR, PSR SSR]
1282 [PSR SSR]
2772 [PSR SSR 1090]
46 [PSR SSR 1090]
2193 [PSR SSR]

25 seconds

Two track sections below 1300ftMSL
10 + 7 = 17 seconds

07/06/2018 00:00:00   07/06/2018 02:24:00   07/06/2018 04:48:00   07/06/2018 07:12:00   07/06/2018 09:36:00   07/06/2018 12:00:00   07/06/2018 14:24:00   07/06/2018 16:48:00   07/06/2018 19:12:00   07/06/2018 21:36:00   07/07/2018 00:00:00

MST-062 Track Number Index

Assumptions:

- Each ADS-B track report has a duration of 1 second
- Each Radar Only track report has a duration of ~5 seconds

P(TOO): Powerline Section 1 (West)
(MST-CAT062: 2000ft buffer and <1300ft MSL ~ 400ft AGL)

Number of CAT062 ADS-B reports = 116

Number of CAT062 Radar Only reports = 101

- P(TOO) = (116*1sec + 101*5sec)/1,209,600 (sec 2 weeks) = **5.13E-04**

(MST-CAT062 reports (2 weeks): 2000ft buffer and <1300ft MSL ~ 400ft AGL)

P(LWC): Powerline Section 1 (West)
(MST-CAT062: 2000ft buffer and <1300ft MSL ~ 400ft AGL)

P(LWC) = P(UAS present)*P(UAS 2000ft)*P(TOO)

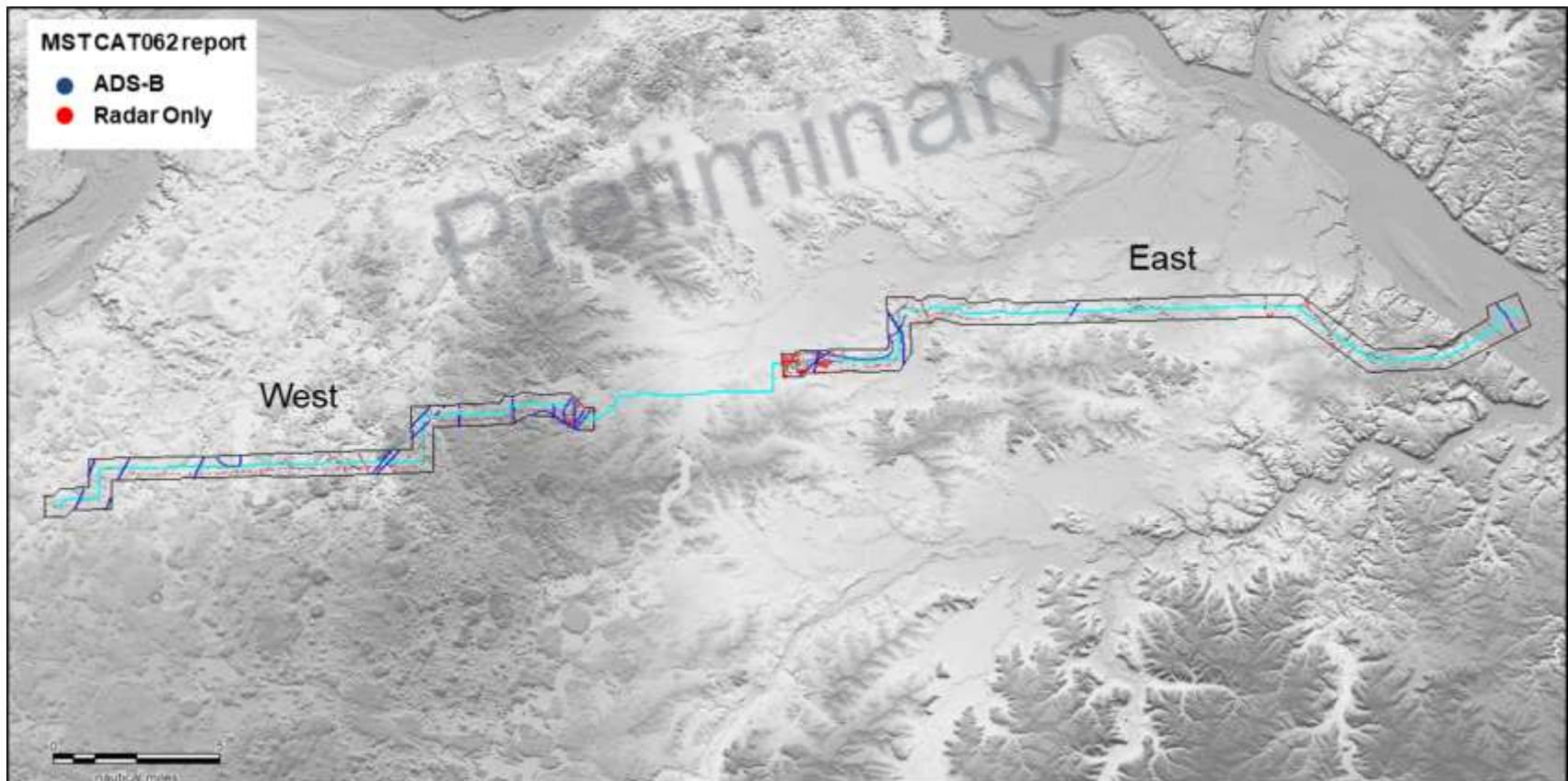- P(LWC) = 7.14E-02 * 2.65E-02 * 5.13E-04 = **9.72E-07**

P(LWC): Powerline Section 1 (West + East)
(MST-CAT062: **2000ft** buffer and **<500ft AGL**) (2 weeks)

P(LWC) = P(UAS present)*P(UAS 2000ft)*P(TOO) = 2.81E-06

- P(UAS present) = 24hrs / 336hrs = **7.14E-02**

- P(UAS 2000ft) = 0.45 mi^2 / (16.88 mi^2 + 22.28 mi^2) = **1.15E-02**

- P(TOO) = (709*1sec + 686*5sec)/1,209,600 (sec 2 weeks) = **3.42E-03**

P(LWC): Powerline Section 1 MSP (West + East)
(MST-CAT062: **2000ft** buffer and **<500ft AGL**) (1 month)

P(LWC) = P(UAS present)*P(UAS 2000ft)*P(TOO) = 2.61E-06

- P(UAS present) = 48hrs / 744hrs = **6.45E-02**

- P(UAS 2000ft) = 0.45 mi² / (16.88 mi² + 22.28 mi²) = **1.15E-02**

- P(TOO) = (2498*1sec + 1385*5sec)/2,678,400 (sec 1 month) = **3.52E-03**