August 13, 2024

From:

Nathaniel Byars, Lonquist & Co. LLC

Julie Shemeta, MEQ Geo Inc.

Re: Combined Monthly Surface Deformation Report – July 2024
Sulphur Mines Salt Dome, Louisiana

Please find attached the combined monthly deformation report for Sulphur Mines dome with results from the precision tiltmeters and GNSS stations for June and July and the cumulative InSAR monitoring to the end of July 2024.

Additional Notes:

- Adjustments have been made to the InSAR corner reflector orientations following TREA's evaluation of signal amplitude. The first reflector InSAR data is anticipated to be available in late September, after two months of baseline data is collected from the adjusted reflectors.

- This report includes the initial monthly evaluation of the calculated 2D InSAR dataset (vertical and east-west) in a similar format to the current LOS (line of sight) reports

Status of a deformation alert plan. As discussed in the "Update on the status of the Tiltmeter and GNSS ground deformation monitoring at Sulphur Mines Salt Dome, Louisiana" dated July 1, 2024, additional time is needed to create a deformation alert system with specific deformation readings from the tiltmeters, GNSS and InSAR monitoring effort. The deformation alert levels will include specific actions and updated reporting schedules as the alert levels progress in severity. In the meantime, while background ground motion values are established, any clearly anomalous deformation readings in any of the monitoring systems shall be promptly reported to the various stakeholders.

Sincerely,

Nathaniel Byars
Principal Engineer
Lonquist & Co. LLC

Julie Shemeta
MEQ Geo Inc.

Attachment List

A. Tiltmeter/GNSS Data Report - June-July 2024
B. SNT InSAR report - July 30, 2024
C. TSX/PAZ InSAR report - July 27, 2024
D. Vertical & East-West 2D InSAR report - July 27, 2024

ATTACHMENT A

Tiltmeter/GNSS Data Report - June-July 2024

August 12, 2024

Dr. Sergey Samsonov

Nathaniel Byars, Lonquist & Co. LLC

Julie Shemeta, MEQ Geo Inc.

Re: Tiltmeter/GNSS Data Evaluation – June-July 2024, Sulphur Mines Salt Dome

The tiltmeter/GNSS network, which includes twenty tiltmeters and five GNSS stations, has been operational since June 1, 2024. It was installed and is currently being operated by Halliburton's Pinnacle Group. Please refer to Figure 1 for the map of the tiltmeter and GNSS stations and Table 1 for their coordinates.

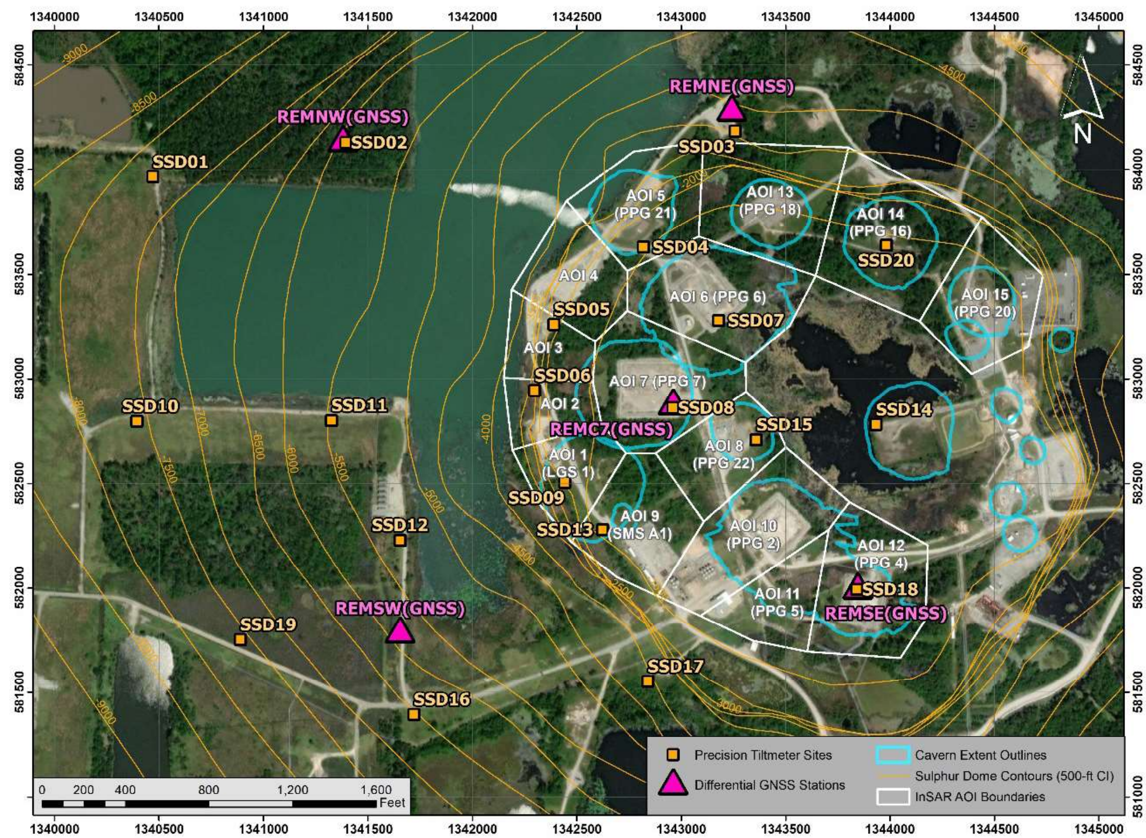


Figure 1. Map of the tiltmeter and GNSS network installed at Sulphur Mines dome. The orange squares indicate the tiltmeter site locations. The GNSS stations are shown by pink triangles. The InSAR AOI boundaries are shown for reference. The surface projection of the various salt caverns is indicated by cyan lines. The salt dome contours are in light orange. The backdrop is an aerial photograph of the Sulphur Mines salt dome.

Table 1. Location of GNSS and Tiltmeter Stations at Sulphur Mines Salt Dome (WGS 84)

Differential GNSS Stations		
Name	**Latitude**	**Longitude**
GPS NE	30.257206	-93.413782
GPS NW	30.256713	-93.419670
GPS Cavern 7 Pad	30.253327	-93.414588
GPS SE	30.250953	-93.411739
GPS SW	30.250263	-93.418668
GPS Off-dome Reference Station	30.257750	-93.426649

Precision Tiltmeter Sites		
Name	**Latitude**	**Longitude**
TILT_01	30.256207	-93.422543
TILT_02	30.256705	-93.419624
TILT_03	30.256947	-93.413727
TILT_04	30.255402	-93.415087
TILT_05	30.254365	-93.416418
TILT_06	30.253489	-93.416695
TILT_07	30.254456	-93.413924
TILT_08	30.253295	-93.414595
TILT_09	30.252288	-93.416215
TILT_10	30.252987	-93.422714
TILT_11	30.253043	-93.419765
TILT_12	30.251485	-93.418691
TILT_13	30.251674	-93.415624
TILT_14	30.253120	-93.411511
TILT_15	30.252891	-93.413320
TILT_16	30.249195	-93.418437
TILT_17	30.249687	-93.414899
TILT_18	30.250951	-93.411754
TILT_19	30.250140	-93.421087
TILT_20	30.255485	-93.411405

Tiltmeter Analyses

Two months of tiltmeter data were analyzed from the Sulphur Mines Salt dome. Dr. Samsonov used a statistical approach to review the data from each tiltmeter station and created multiple plots to identify both long-term and short-term trends in the readings. This helped to detect any abnormal deformation behavior related to Cavern 7.

Tiltmeters are sensors that can measure subtle changes in ground slope (i.e., tilt angle) in two directions: North-South and East-West. These sensors are highly sensitive and can detect small changes in tilt angle, as little as a fraction of microradian. One microradian (equivalent to 0.00006 degrees) is approximately the tilt caused by placing a dime under one end of a beam that is one half-mile long (USGS Volcano Hazards Program). When monitoring the Sulphur Mines dome, each tiltmeter site is evaluated individually and then all tiltmeters are assessed as a network to identify patterns in the data that suggest ground deformation related to subsurface movement near Cavern 7. These patterns are evaluated in relation to prior baseline readings and trends. Tiltmeters can also detect other local physical phenomena such as daily tidal changes and local weather, which may not be related to cavern deformation but can still affect the readings. The measurements taken in June and July are displayed in four plots for each station, as shown in Appendix 1. The plots are described below.

The long-term trend for each tiltmeter. The graphs in the top row display the raw tiltmeter signals observed at each monitoring station during June and July for both the north-south and east-west directions. In the north-south direction (left graph), a positive tilt indicates the vertical displacement decreases in the north direction (i.e., tilt towards the north). In the east-west direction (right graph), a positive tilt indicates the vertical displacement decreases in the east direction (i.e., tilt towards the east). The red solid line on each graph represents the overall tilt trend, with the slope of the line indicating the annual tilt rate. The mean value and standard deviation of the tilt rate, calculated using linear regression analysis, are labeled above the graph. The lateral distance of the tiltmeter station from the centroid of the sonared interior of Cavern 7 is listed at the top of the plot.

Detrended tiltmeter for each component. The graphs in the second row are used to identify small changes in the tilt signals that could be hidden by the overall trend, the raw tiltmeter signals are adjusted (i.e., detrended) by removing the linear model from the raw tilt data. The detrended data is then shown with dashed lines representing the mean value, as well as 1, 2, and 3 standard deviations for that station. This approach allows for a detailed examination of a station's tiltmeter readings that occurred over short time intervals, which can help to identify any unusual movement compared to what is typically observed at that station.

Daily tiltmeter motion maximum and minimum behavior. The graphs in the third row display the daily tilt ranges, calculated as the difference between the maximum and minimum daily tilt readings. The daily ranges are displayed along with the mean and 1, 2, and 3 standard deviation values for that station, which are indicated by dashed lines. This provides a quick way to identify any unusual changes in daily tilt magnitude.

Monthly tilt direction with respect to Cavern 7. The graph in the fourth row displays the distribution of daily tilt directions over the past two months. The tilt direction is the azimuth defined by the daily north-south and east-west tilt magnitudes. This data is then presented using a rose diagram, also known as an angular histogram. The diagram includes a small red hash mark on the outer perimeter to indicate the angular direction to Cavern 7 for each station.

Summary of Tiltmeter Results for June and July 2024. Based on the tiltmeter data, no consistent pattern of ground movement is present that suggests an immediate issue with Cavern 7. Some small but important changes in tilt were observed during the June-July period. For example, on June 17 around 8:40 am, significant tilt changes were seen at several stations, which seems to have been caused by heavy rainfall (about 1.5 inches) that occurred from 6:30 to 9:00 am. Tilt changes were also linked to a smaller rainfall event on June 26 at around 5:00 pm. Again, in late July, significant tilt changes were observed that correlated to a multi-day rain event which resulted in greater than 6 inches of rainfall from July 23 through July 26. Other anomalies in the tiltmeter data are not related to weather and seem to be linked to local, possibly shallow features in the near-surface, such as movement in the cap rock. The cause of significant but steady tilt values observed at several sites remains uncertain and is being investigated. Persistent changes in the tilt signals at a few stations immediately following the rain event in late July are still being investigated.

GNSS observations

The GNSS data measures the displacement of the GNSS station from its initial position over time. The results include three components, in north-south, east-west, and vertical directions. The initial location of the GNSS site is subtracted from the time series to show the displacement starting from zero. When measured over a short period (days to a few months), the GNSS measurements appear noisy. To better observe the deformation signal, a simple moving average computed over a 100-hour interval and a linear trend computed using linear regression are provided. It's important to note that the vertical time series shows the actual vertical motion, which is of primary interest. However, the horizontal time series shows a combination of displacement due to local processes (which are of primary interest as well) and displacements due to tectonic plate motion, which are common to all sites. Therefore, to estimate relative horizontal motion between GNSS sites, we need to look at time series differences. For instance, to measure horizontal motion in the north-south directions between NE and SW sites, we need to subtract the corresponding time series or deformation rates computed using linear regression. This will be described in more detail in the next report.

The GNSS station results for June and July are shown in Appendix 2. To improve measurement precision individual readings beyond three standard deviations were removed as outliers. The two-month trend for each component is shown as a red line and the 100-hour average is the blue line. The average annual deformation rate and standard deviation are computed for each component and shown in red.

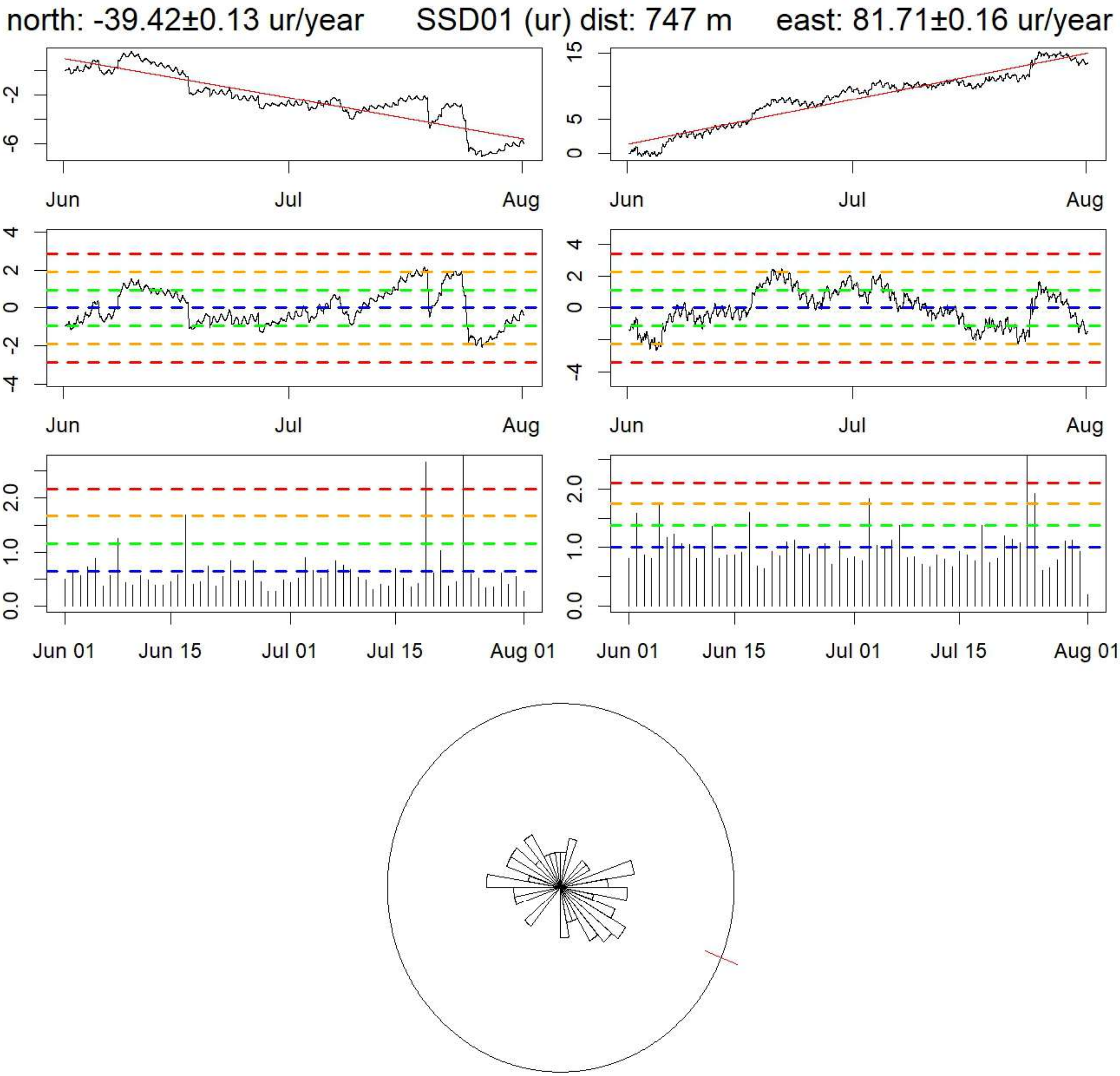
The missing July data at the NE GNSS station occurred due to an antenna failure. Data recording commenced again in late July following an antenna replacement. We are currently investigating the abnormal vertical motion at the NW GNSS station observed in mid-July. Pinnacle has noted that this vertical movement may have been an internal correction and that the standard deviation in the data decreased (quality increased) following the change. They also noted that this time period corresponds with tree clearing that occurred at the NW GNSS site to improve sky exposure, and that tiltmeters in the vicinity do not indicate any corresponding ground movement.

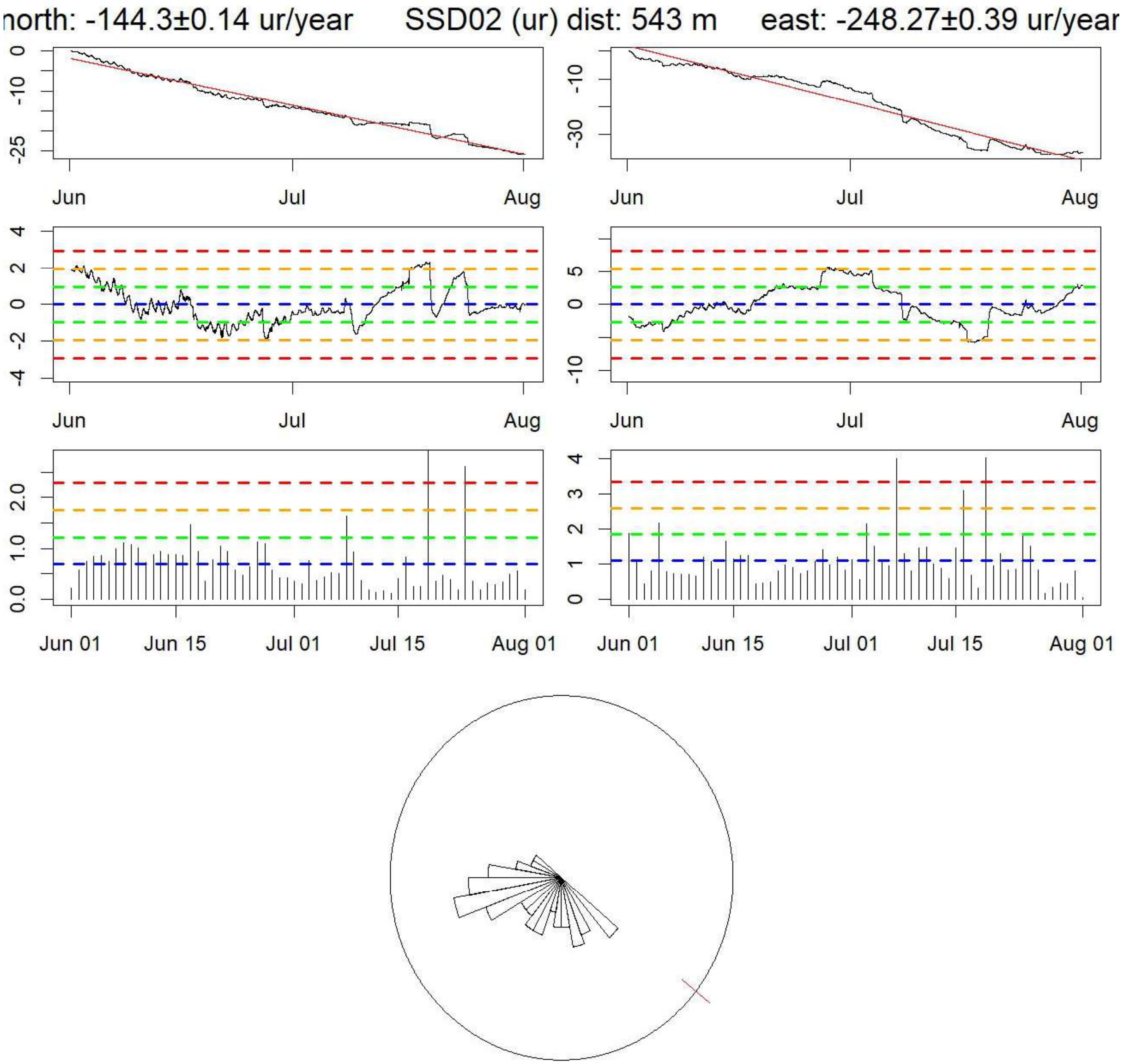
The GNSS data is noisy, and two months of observations is only marginally adequate to achieve high measurement precision. Nevertheless, it is already clear that the deformation rates at the GNSS stations are relatively low and appear to be on the order of historically recorded subsidence rates around the dome. As additional observations at the GNSS stations are acquired, this data will be given a large weight in assessing long-term deformation trends at the Sulphur Mines dome.

Future reporting
The observation and analysis methodology for the tiltmeter and GNSS data is still in development and continued improvements are anticipated as additional data becomes available. Enhancements to the data evaluation and interpretation system will be implemented in future reports as this effort progresses.

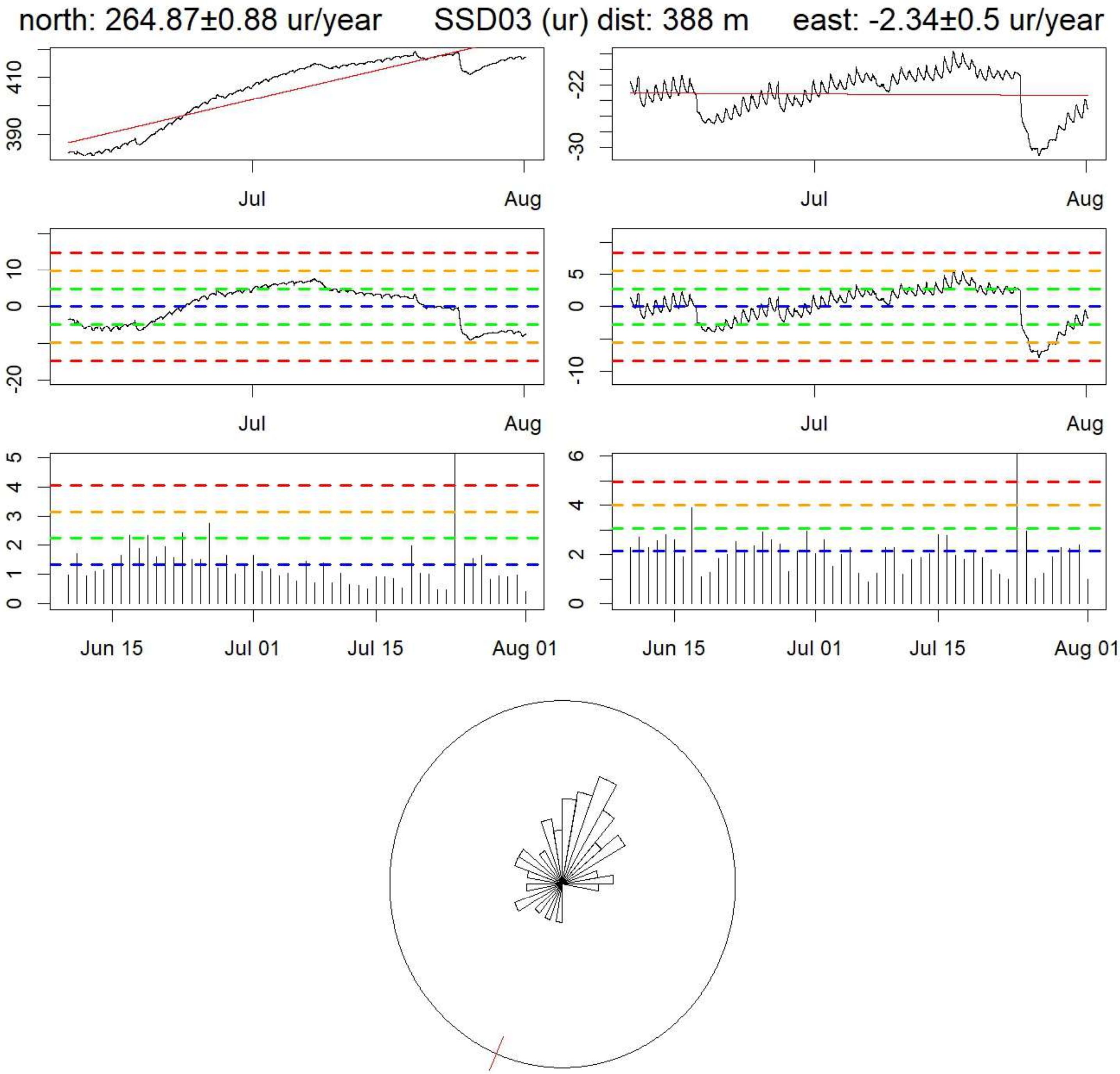
APPENDIX 1

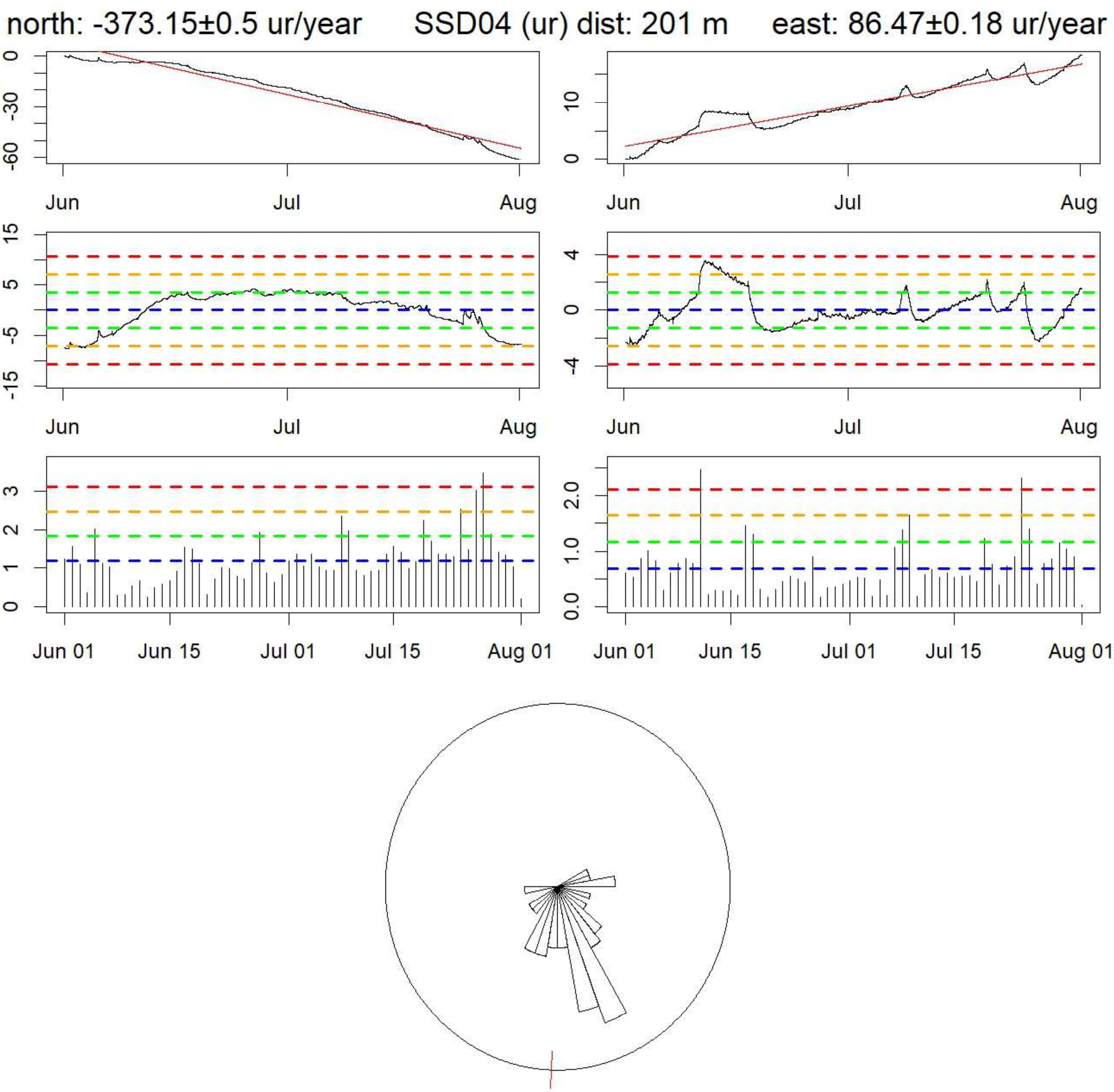
Tiltmeter Data Plots - June-July 2024


north: -39.42±0.13 ur/year
SSD01 (ur) dist: 747 m
east: 81.71±0.16 ur/year
Jun
Jul
Aug
Jun 01
Jun 15
Jul 01
Jul 15
Aug 01

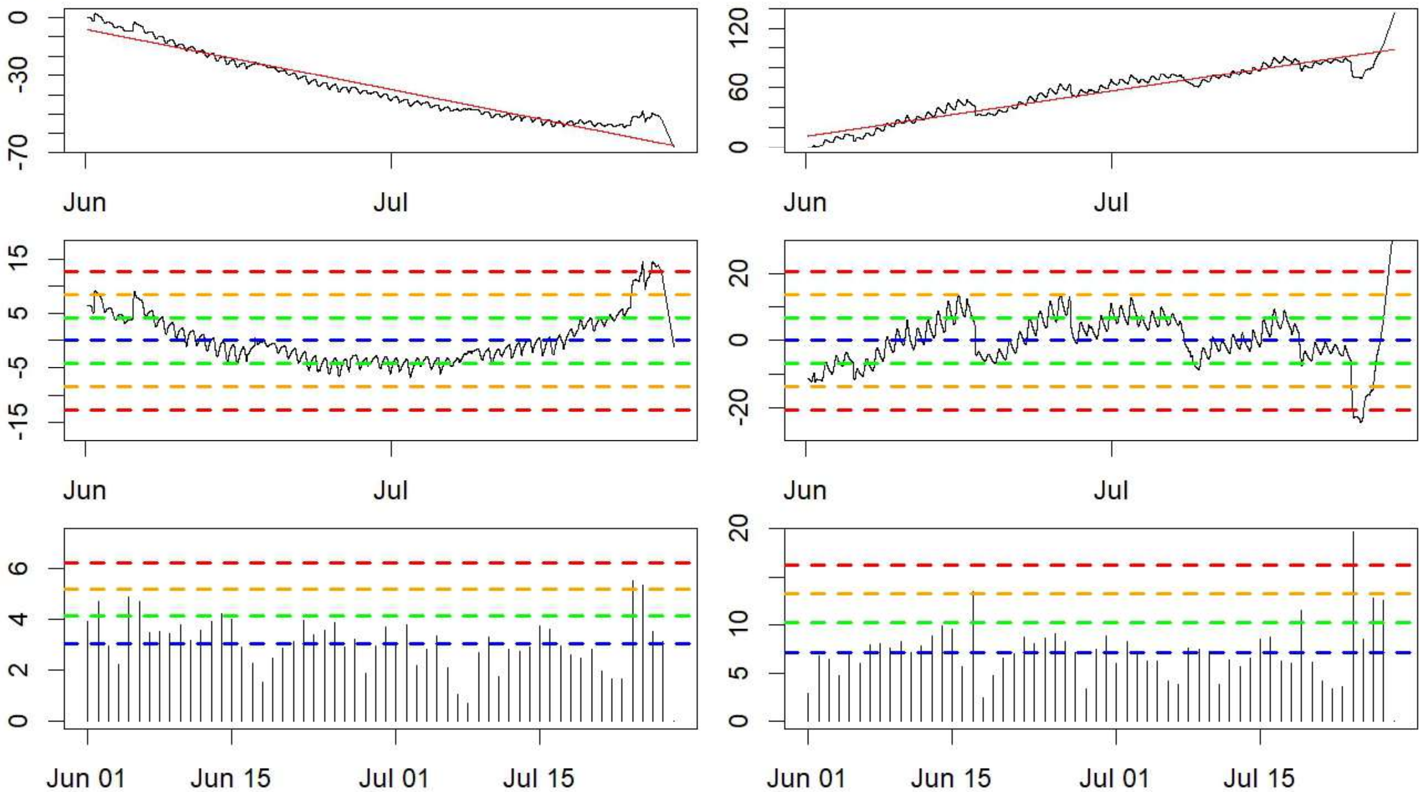


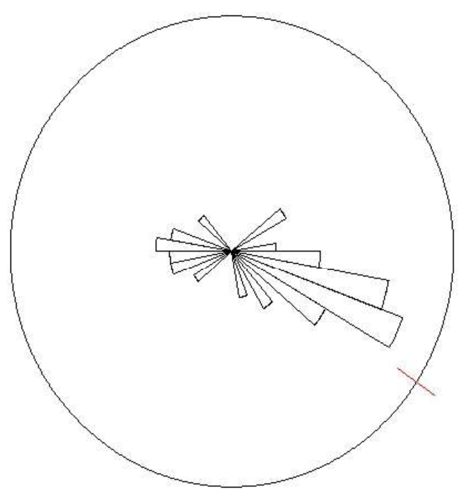
north: -144.3±0.14 ur/year
SSD02 (ur) dist: 543 m
east: -248.27±0.39 ur/year
Jun
Jul
Aug
Jun 01
Jun 15
Jul 01
Jul 15
Aug 01

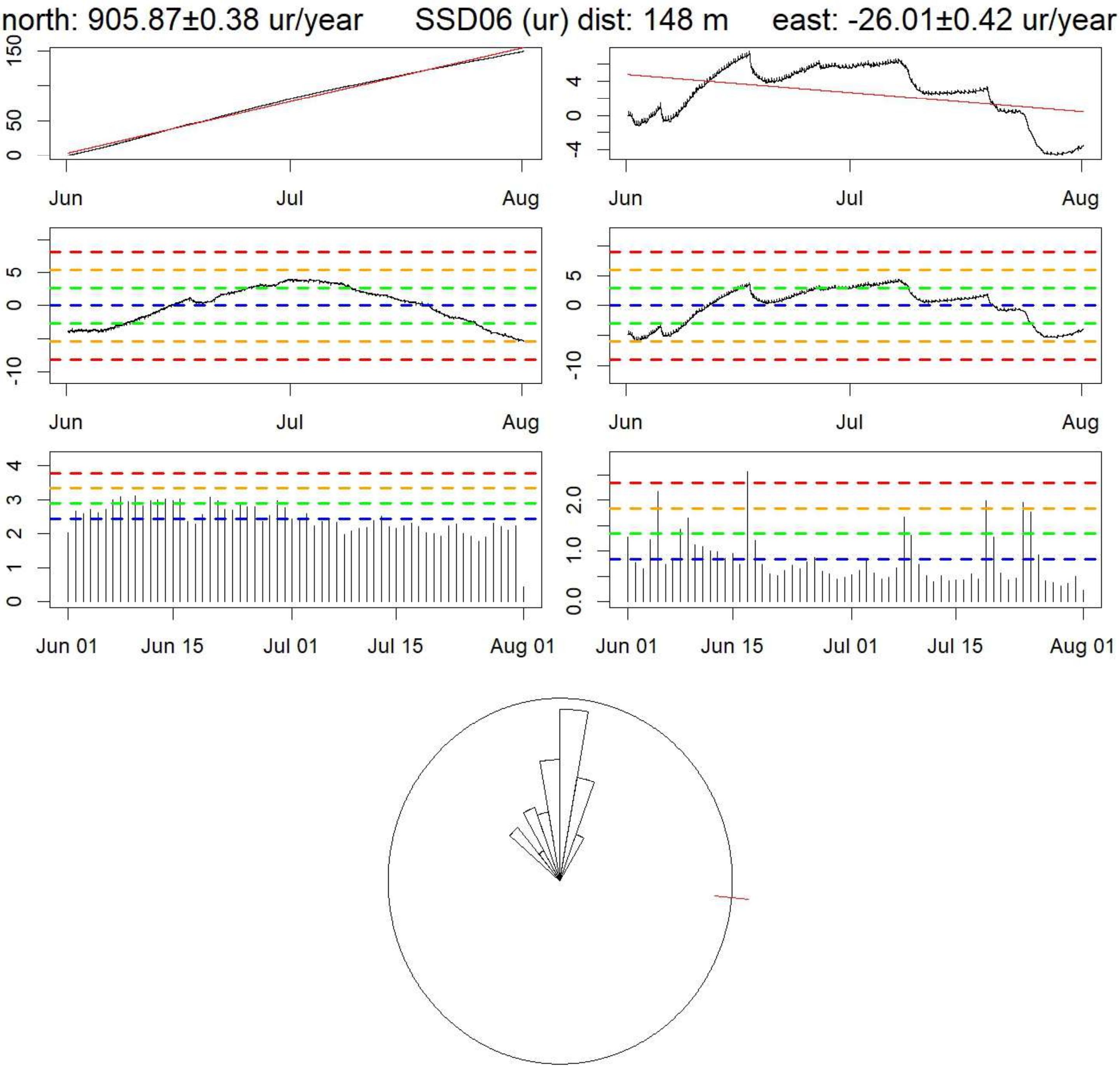

north: 264.87±0.88 ur/year
SSD03 (ur) dist: 388 m
east: -2.34±0.5 ur/year
Jul
Aug
Jun 15
Jul 01
Jul 15
Aug 01

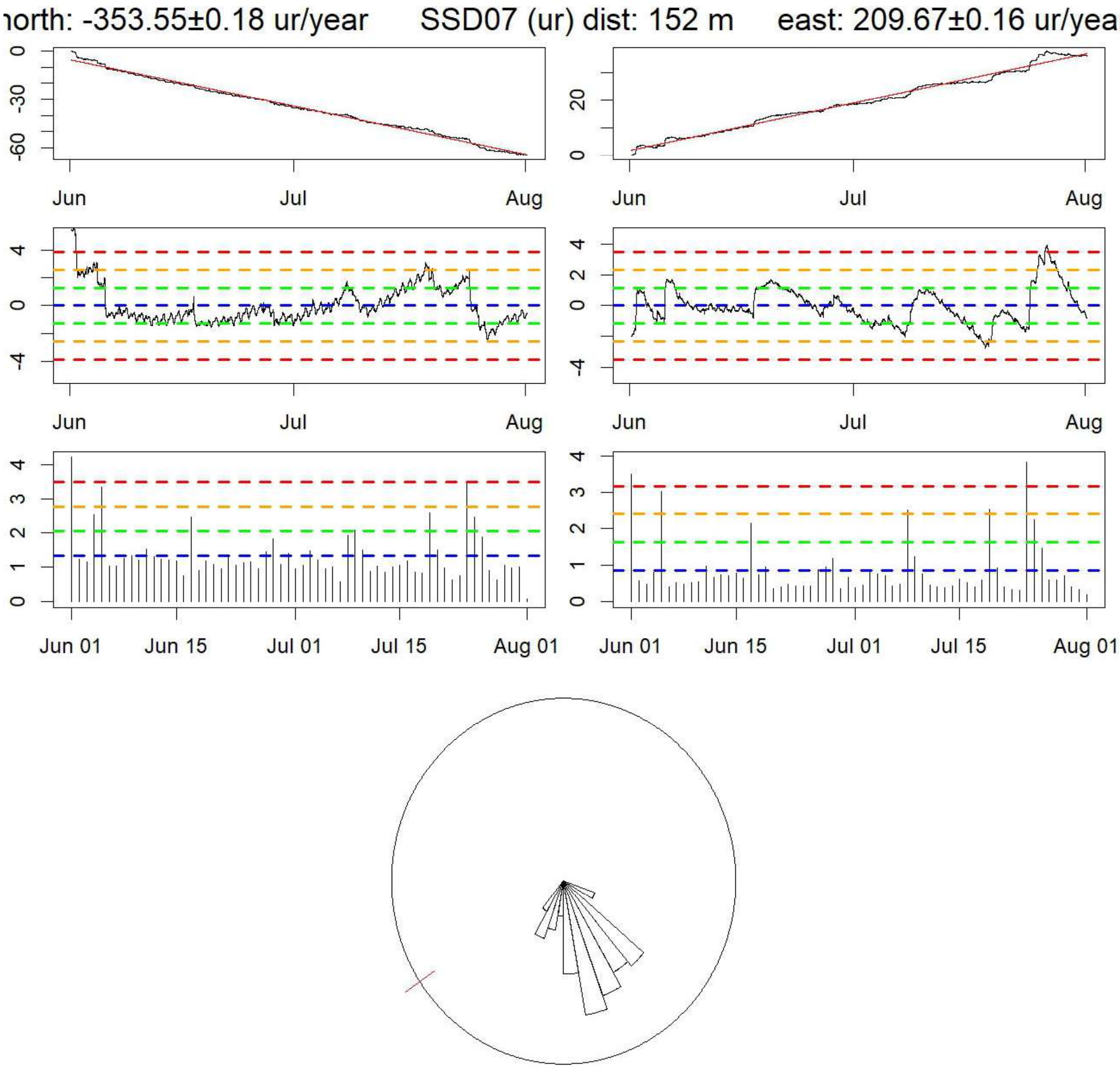

north: -373.15±0.5 ur/year
SSD04 (ur) dist: 201 m
east: 86.47±0.18 ur/year
0
-30
-60
10
0
Jun
Jul
Aug
15
5
-5
-15
4
0
-4
3
2
1
2.0
1.0
0.0
Jun 01
Jun 15
Jul 01
Jul 15
Aug 01

north: -380.7±0.69 ur/year SSD05 (ur) dist: 141 m east: 554.42±1.12 ur/year

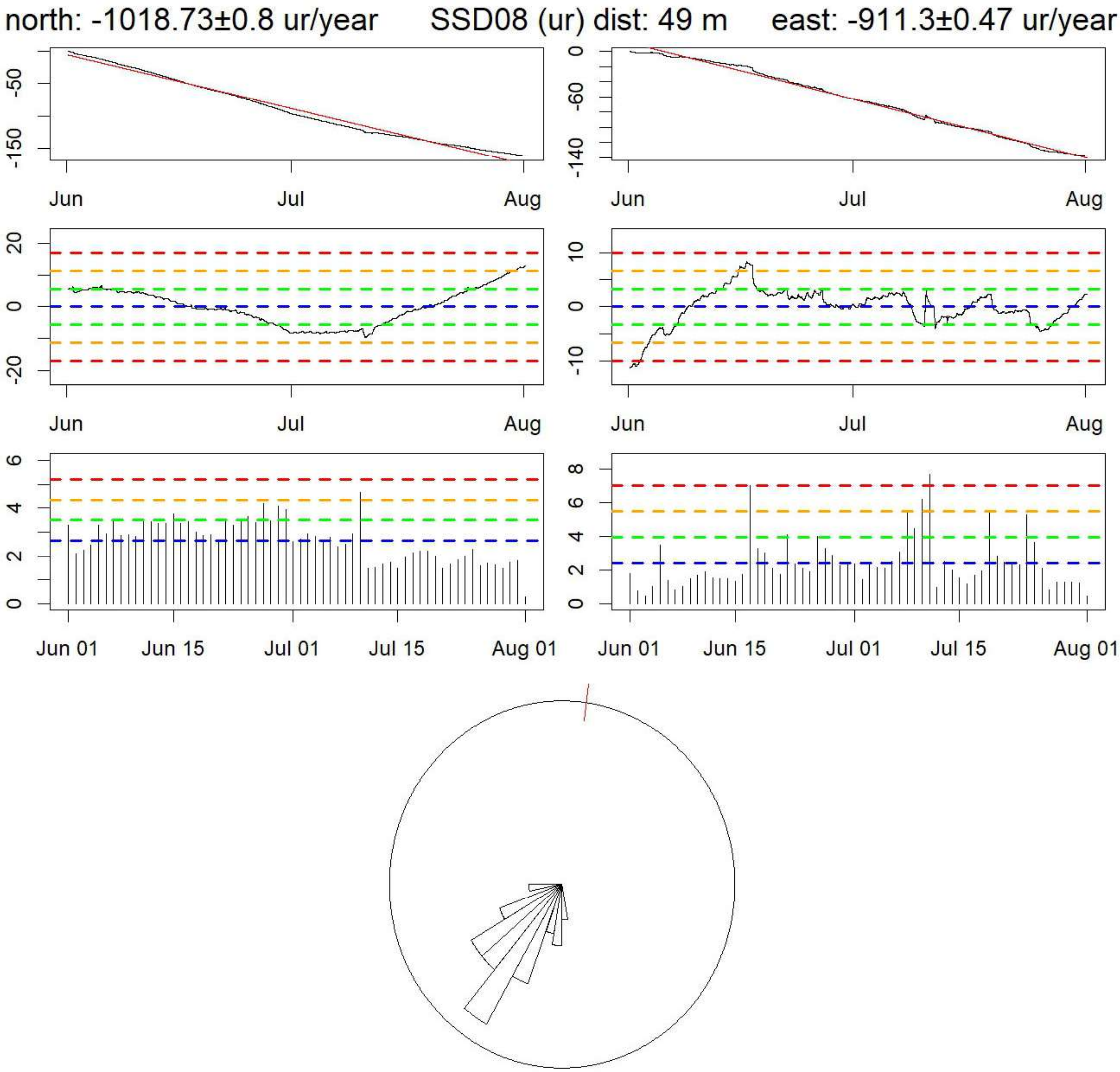





north: 905.87±0.38 ur/year
SSD06 (ur) dist: 148 m
east: -26.01±0.42 ur/year
0
50
150
Jun
Jul
Aug
-4
0
4
Jun
Jul
Aug
-10
0
5
Jun
Jul
Aug
-10
0
5
Jun
Jul
Aug
0
1
2
3
4
Jun 01
Jun 15
Jul 01
Jul 15
Aug 01
0.0
1.0
2.0
Jun 01
Jun 15
Jul 01
Jul 15
Aug 01

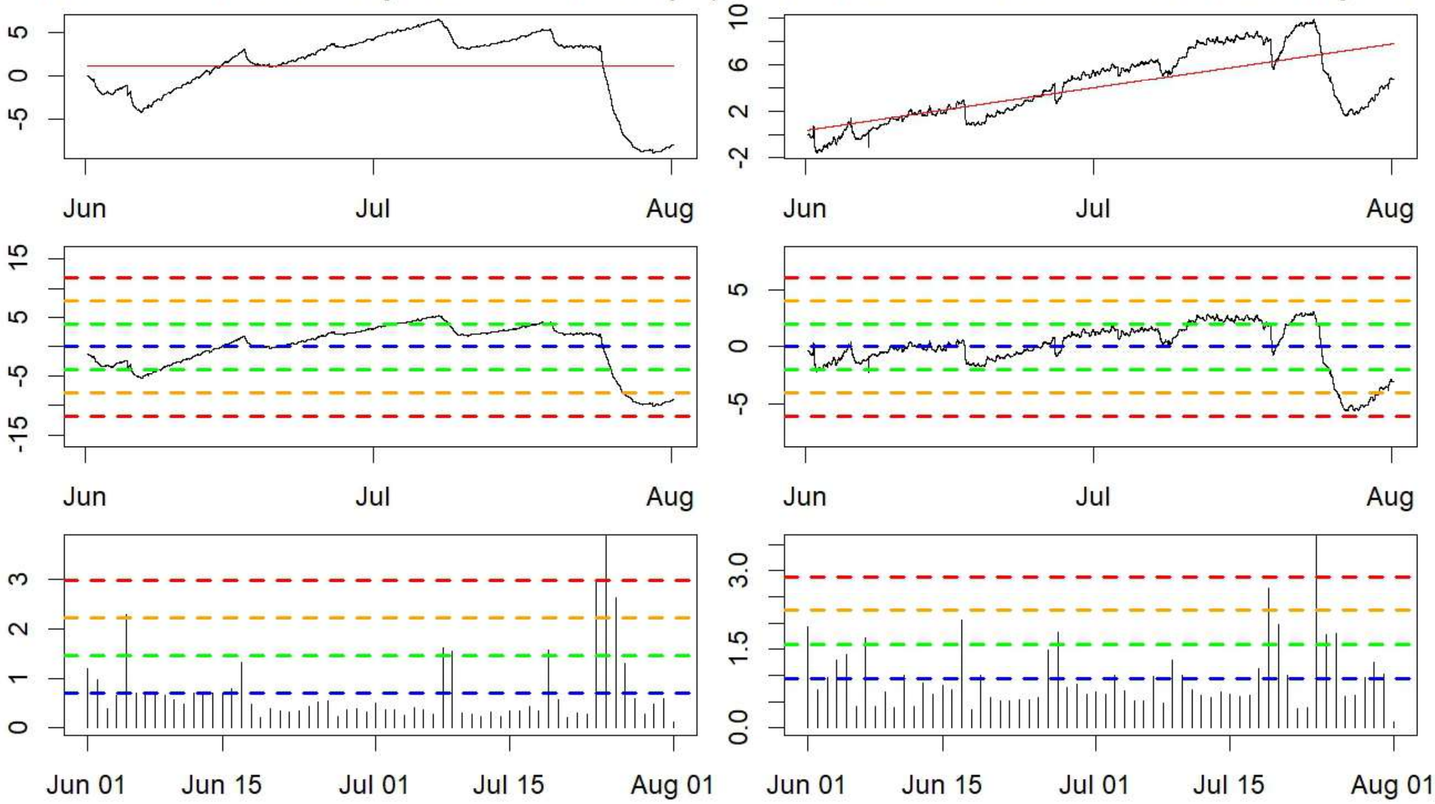


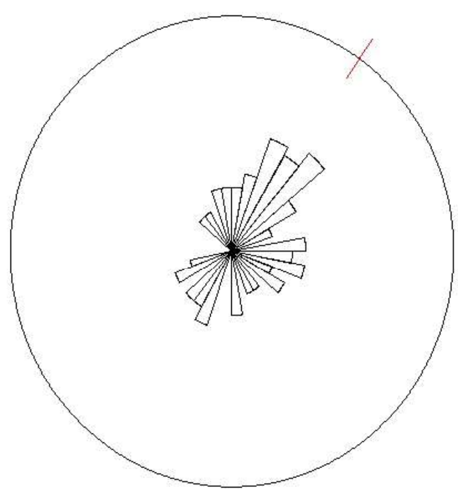
north: -353.55±0.18 ur/year
SSD07 (ur) dist: 152 m
east: 209.67±0.16 ur/year
Jun
Jul
Aug
Jun 01
Jun 15
Jul 01
Jul 15
Aug 01



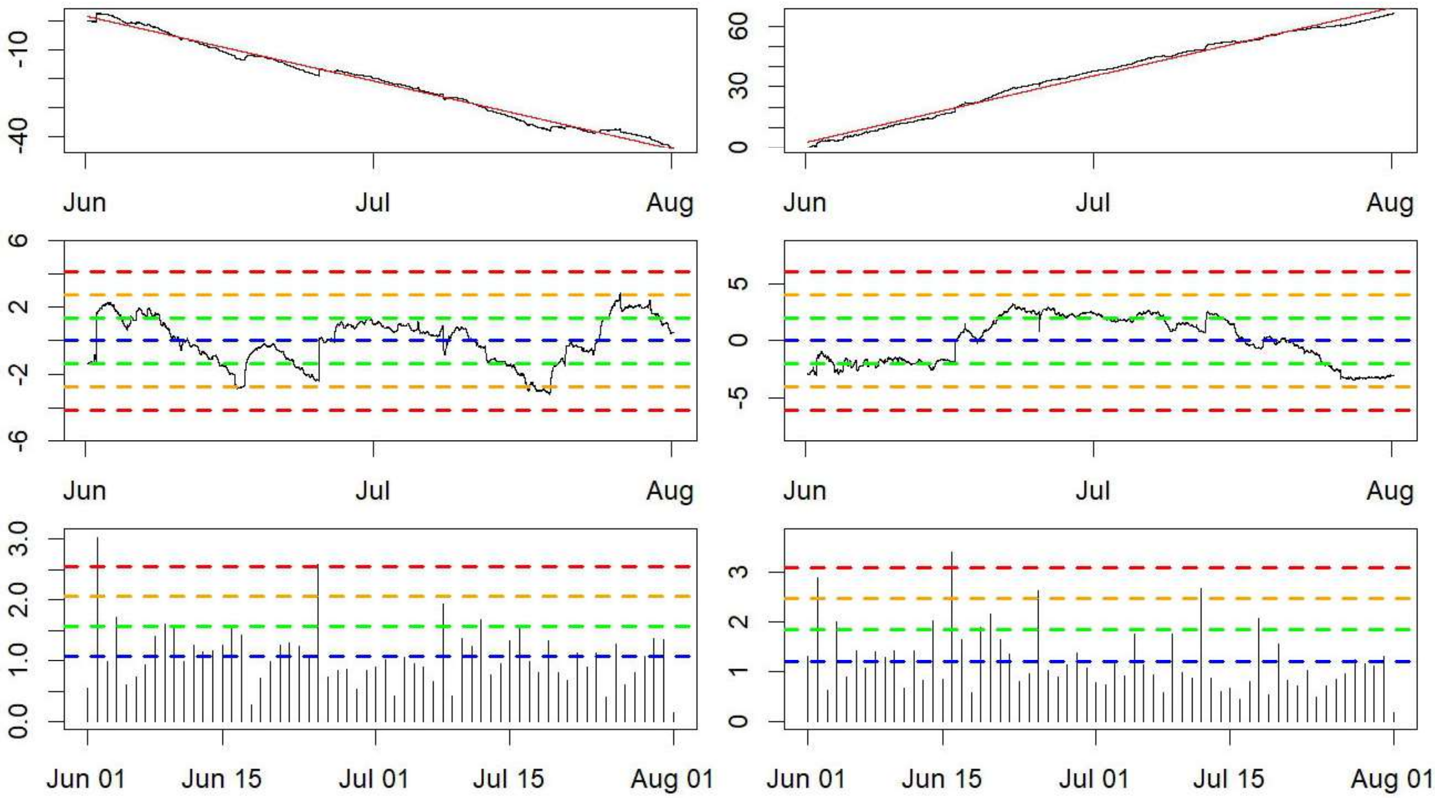
north: -1018.73±0.8 ur/year
SSD08 (ur) dist: 49 m
east: -911.3±0.47 ur/year
-50
-150
0
-60
-140
Jun
Jul
Aug
20
0
-20
10
0
-10
6
4
2
0
8
6
4
2
0
Jun 01
Jun 15
Jul 01
Jul 15
Aug 01

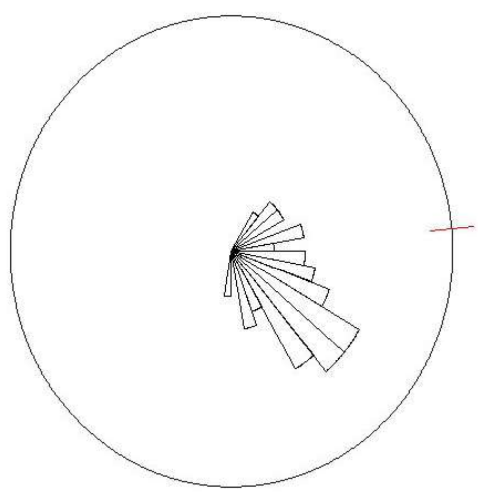
north: -0.24±0.56 ur/year   SSD09 (ur) dist: 178 m   east: 44.56±0.29 ur/year



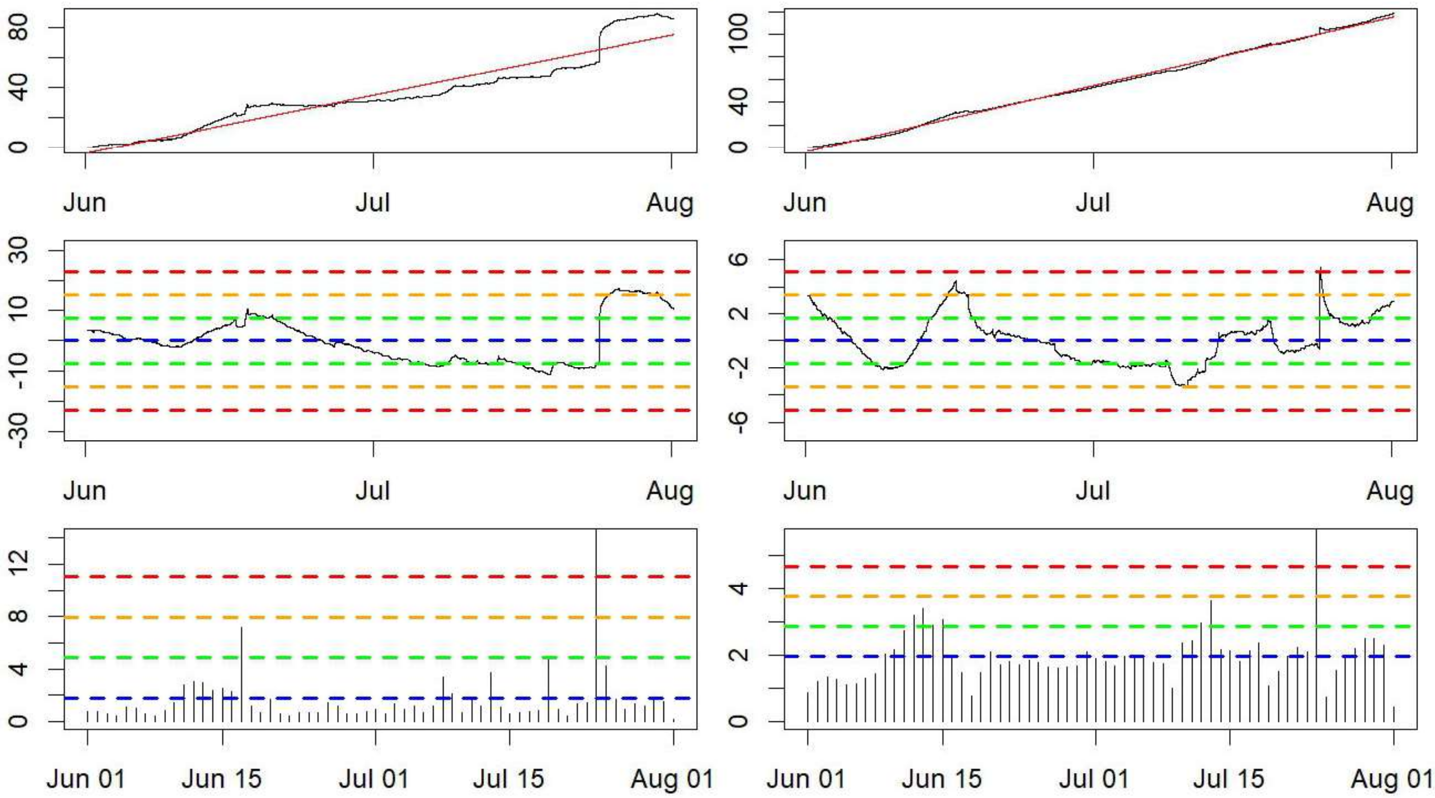


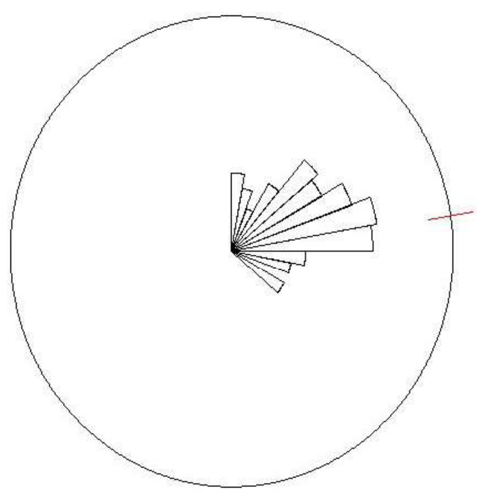
north: -274.9±0.2 ur/year SSD10 (ur) dist: 690 m east: 398.92±0.29 ur/year

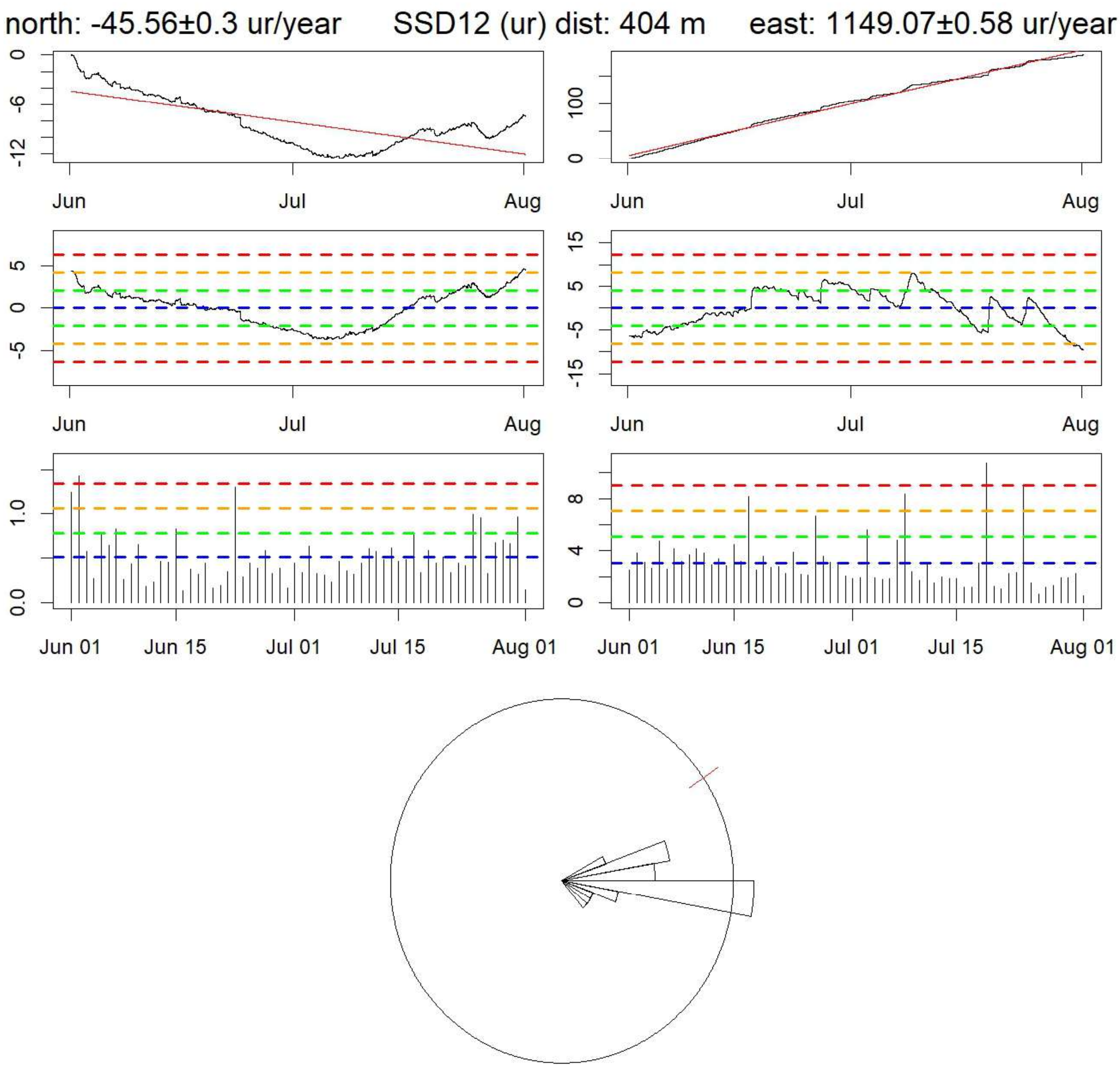




north: 471.71±1.08 ur/year   SSD11 (ur) dist: 436 m   east: 712.64±0.24 ur/year

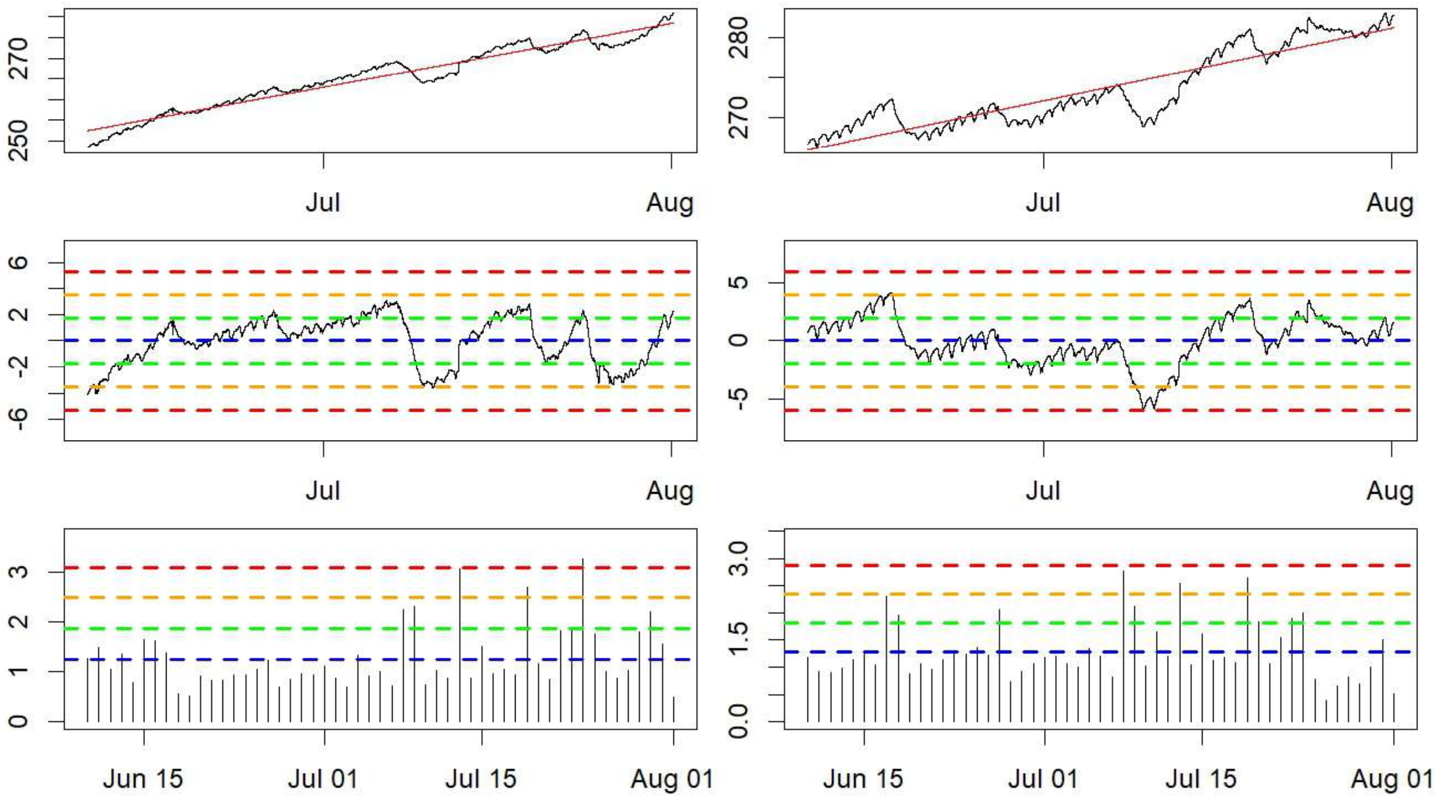


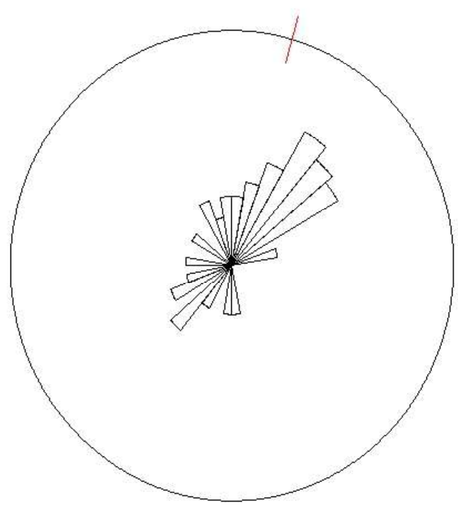




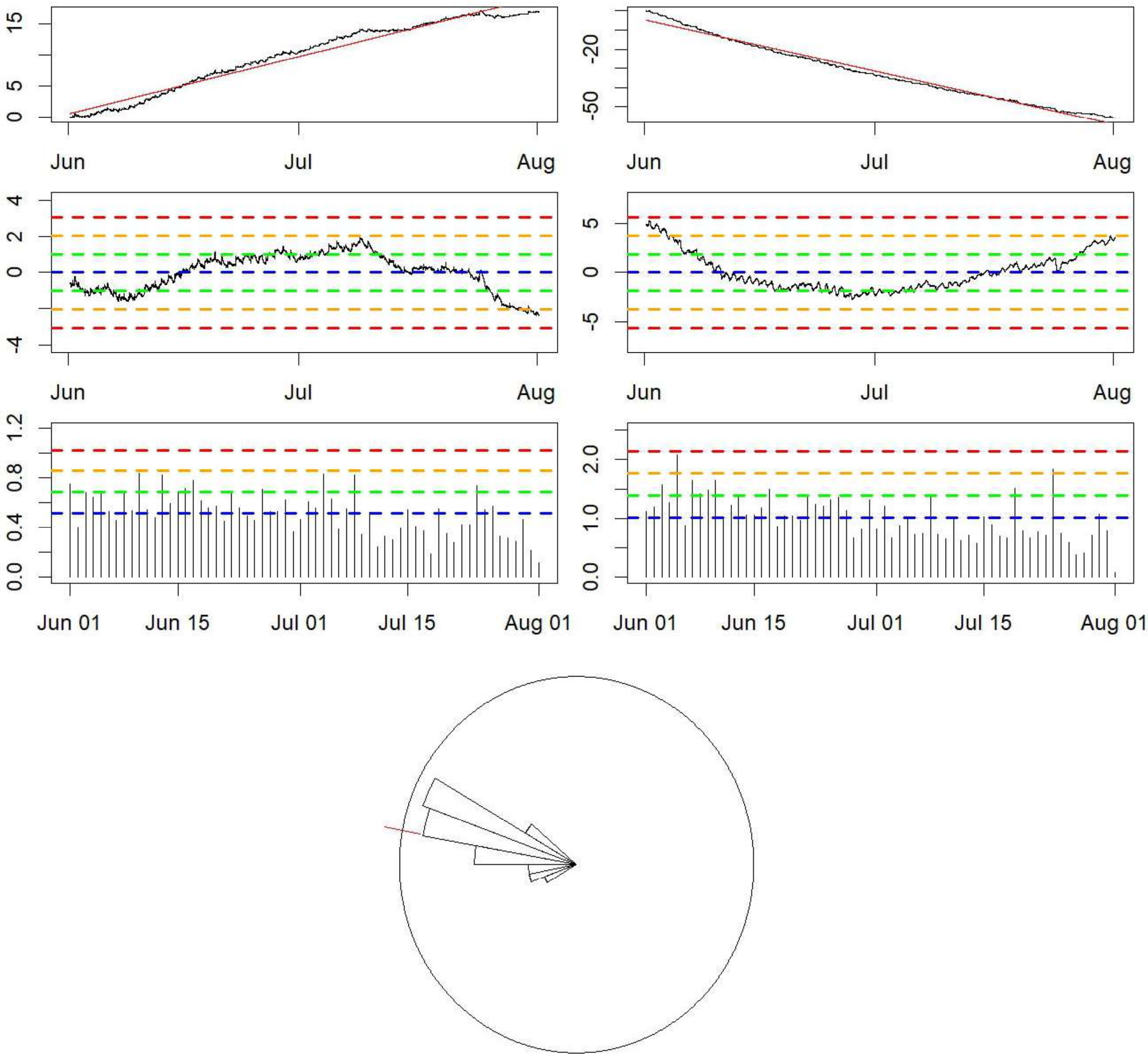
north: -45.56±0.3 ur/year
SSD12 (ur) dist: 404 m
east: 1149.07±0.58 ur/year
Jun
Jul
Aug
Jun 01
Jun 15
Jul 01
Jul 15
Aug 01

north: 182.76±0.32 ur/year SSD13 (ur) dist: 224 m east: 107.96±0.36 ur/year

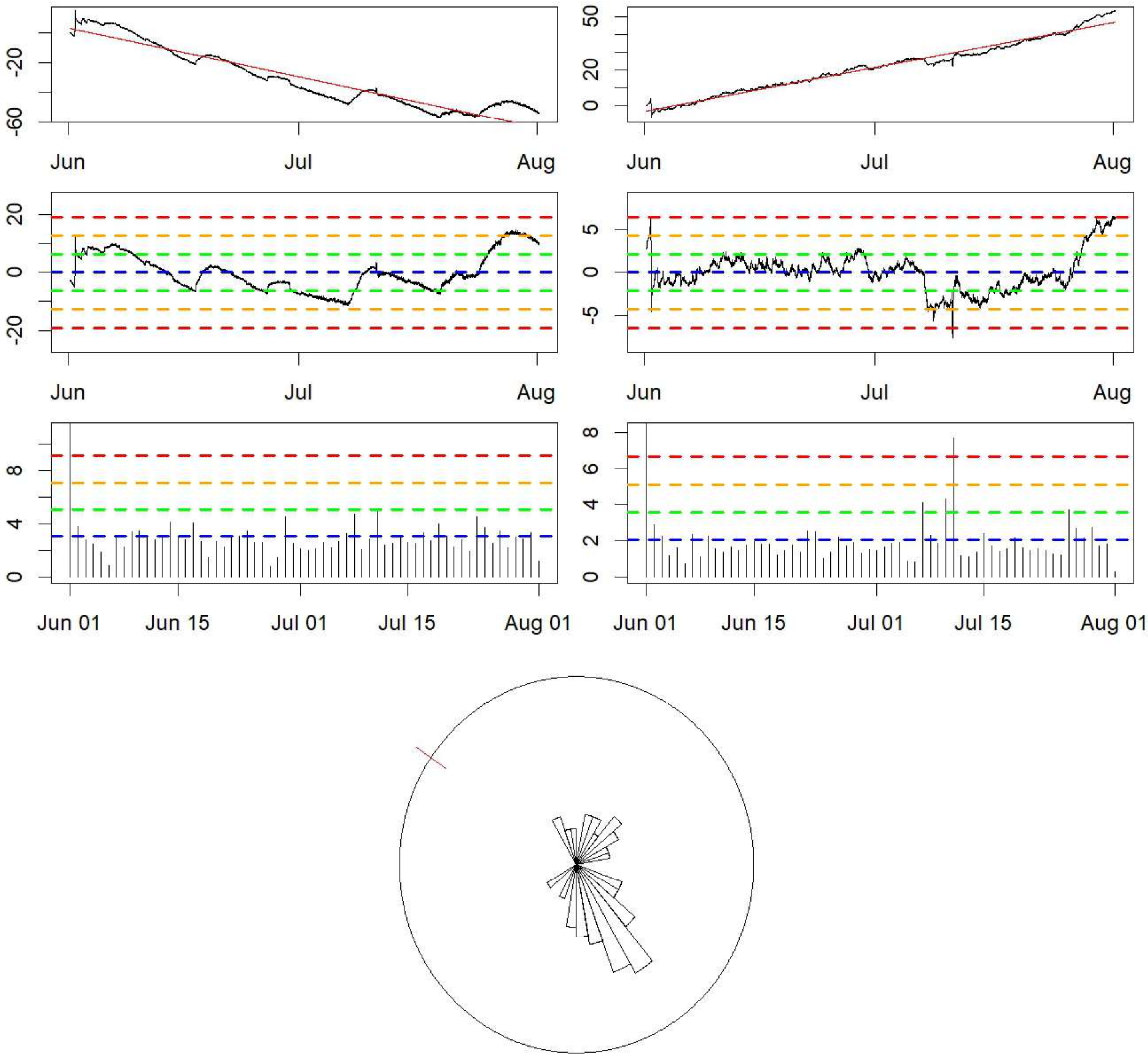




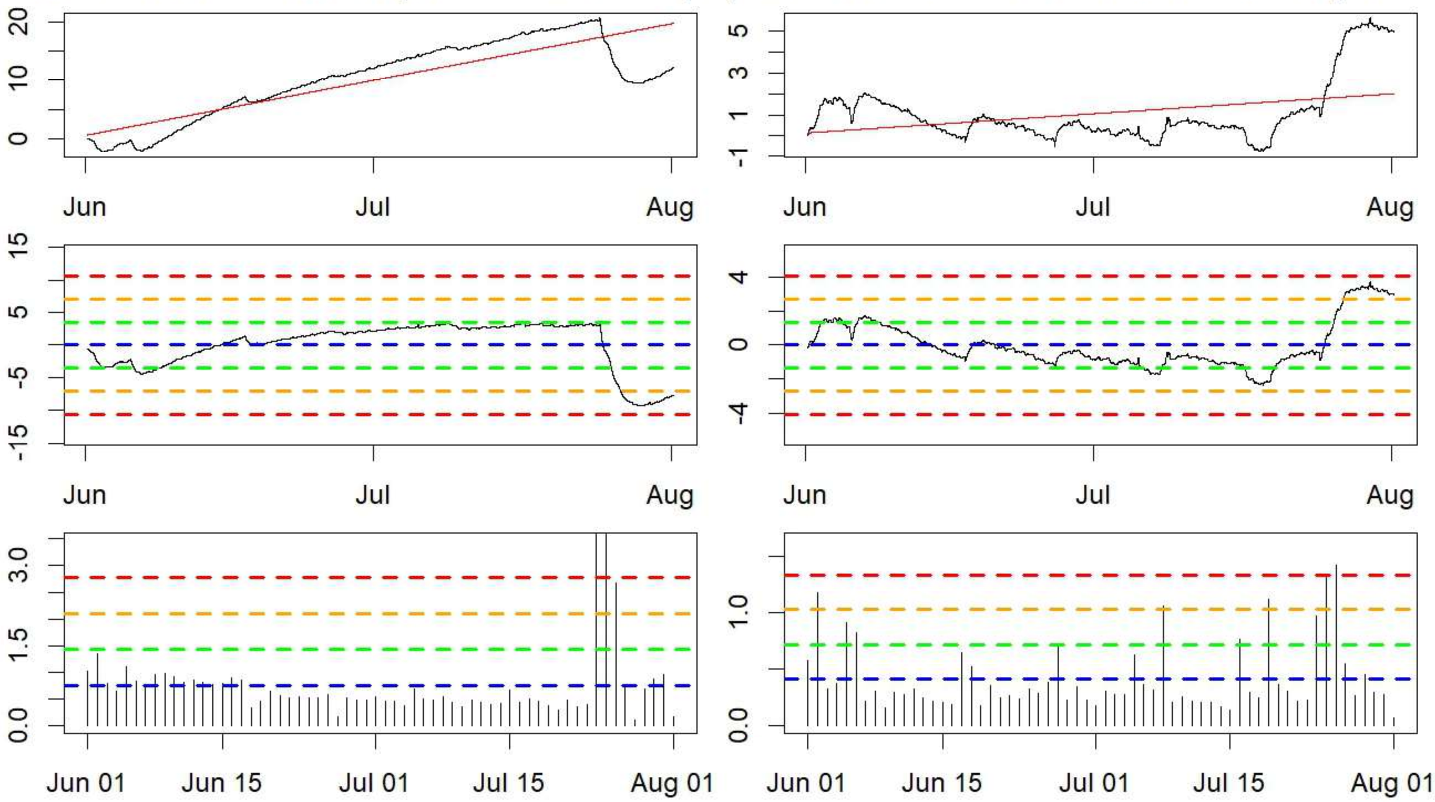
north: 112.38±0.14 ur/year SSD14 (ur) dist: 369 m east: -326.7±0.26 ur/year

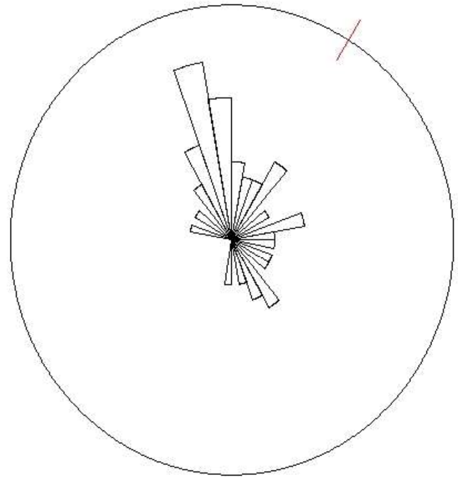


north: -400.2±0.89 ur/year SSD15 (ur) dist: 205 m east: 299.35±0.3 ur/year

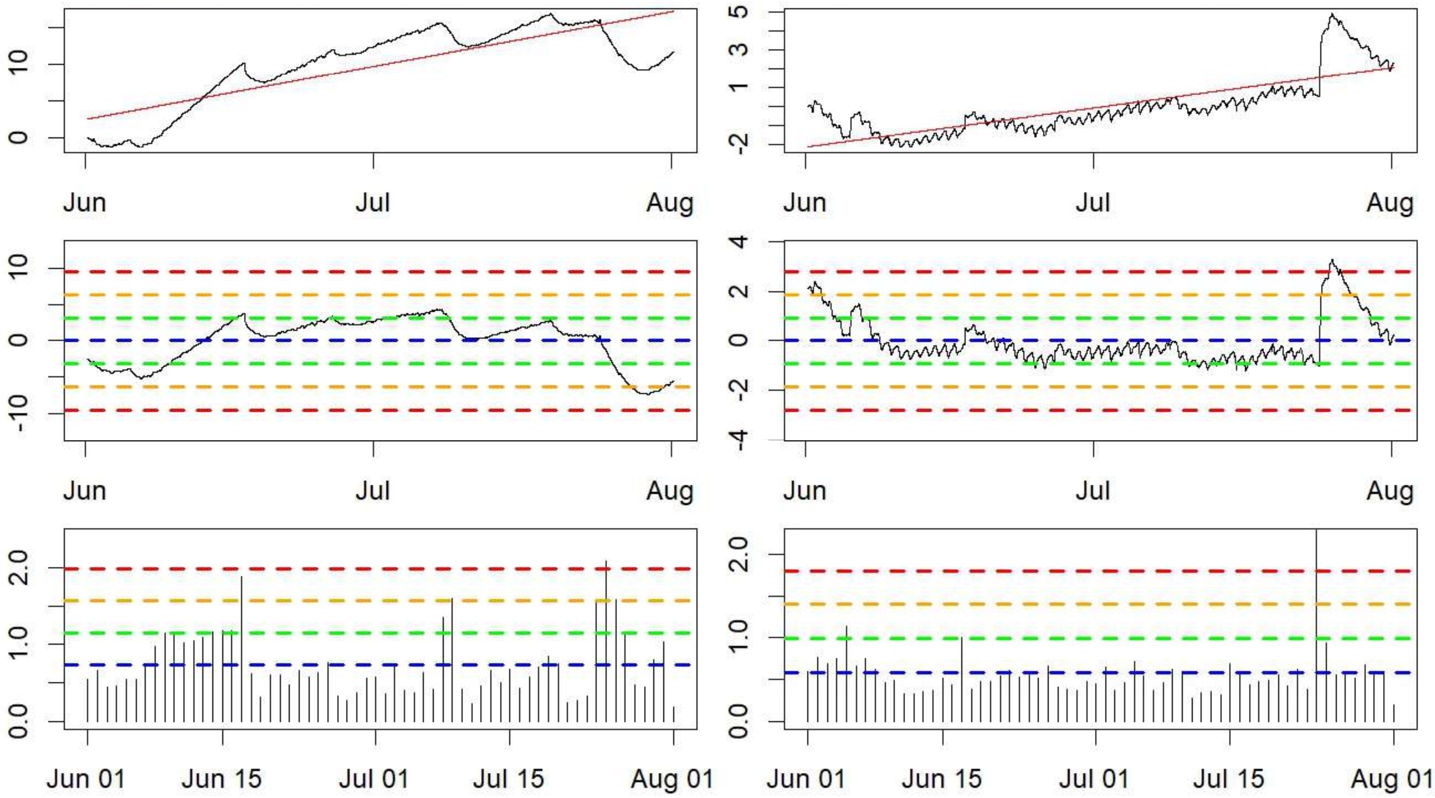


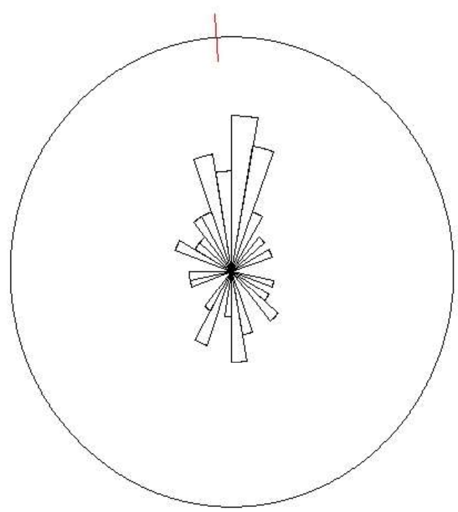
north: 115.21±0.5 ur/year   SSD16 (ur) dist: 586 m   east: 11.2±0.19 ur/year



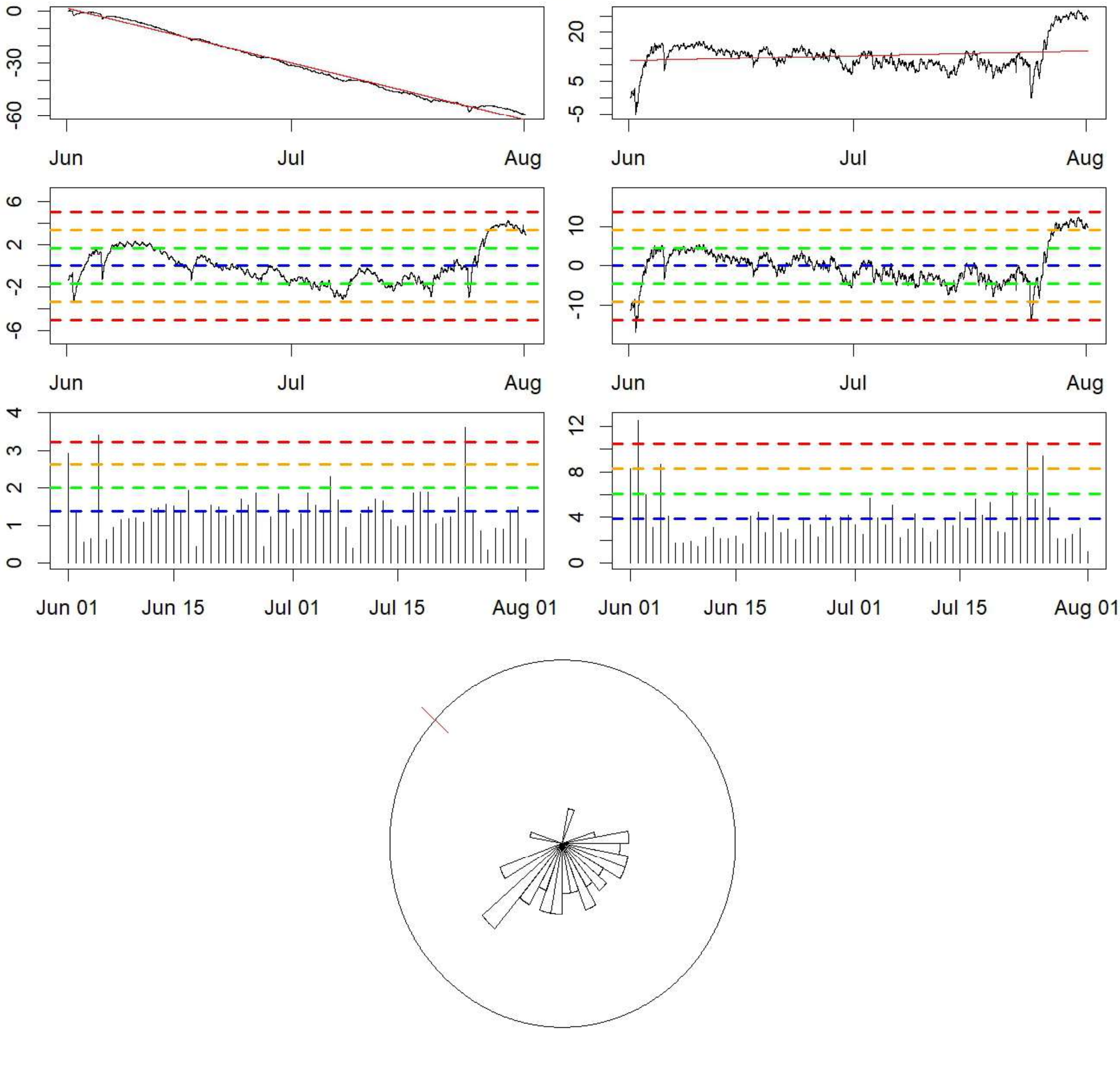


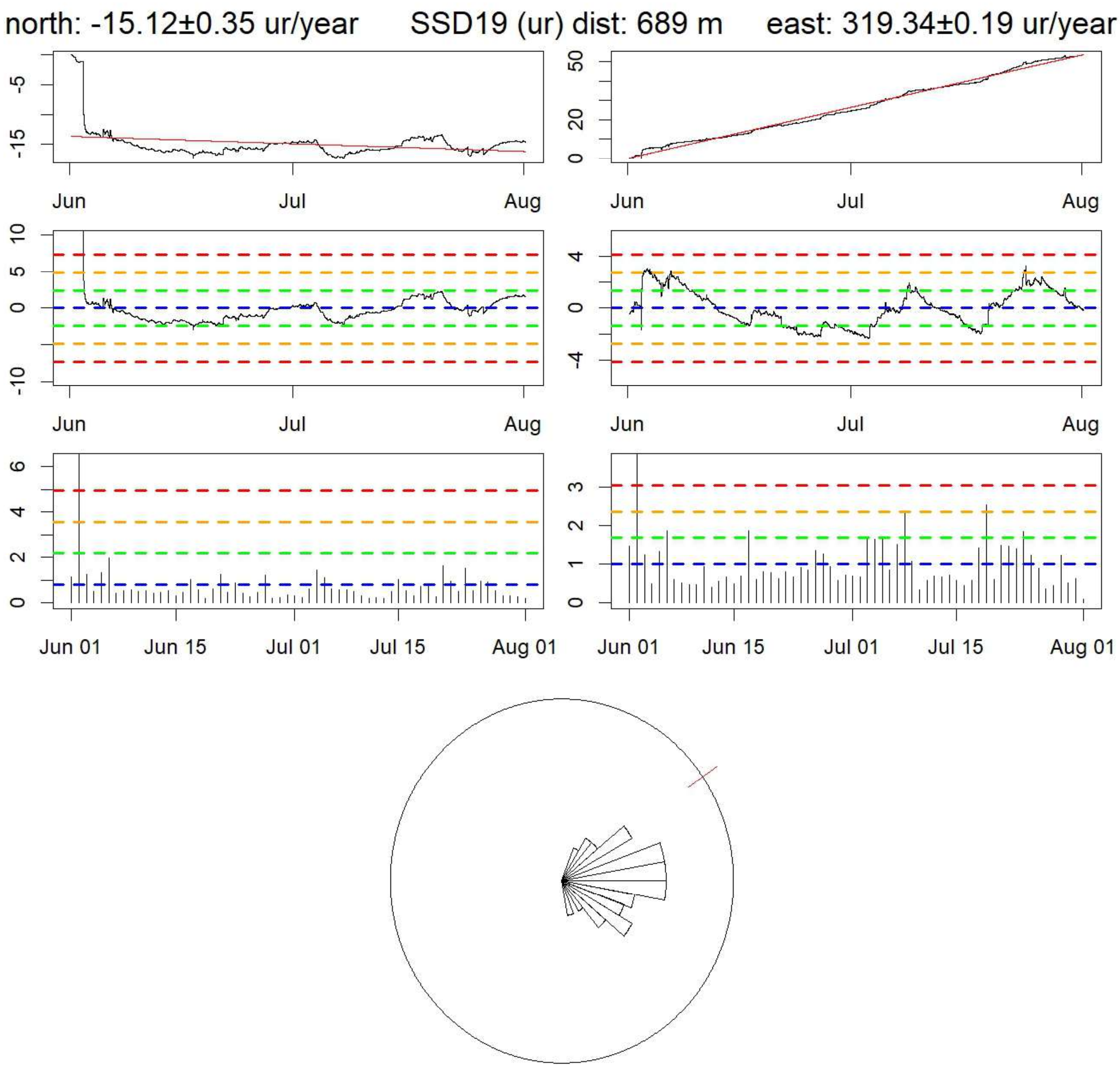
north: 88.07±0.45 ur/year SSD17 (ur) dist: 446 m east: 25.02±0.13 ur/year





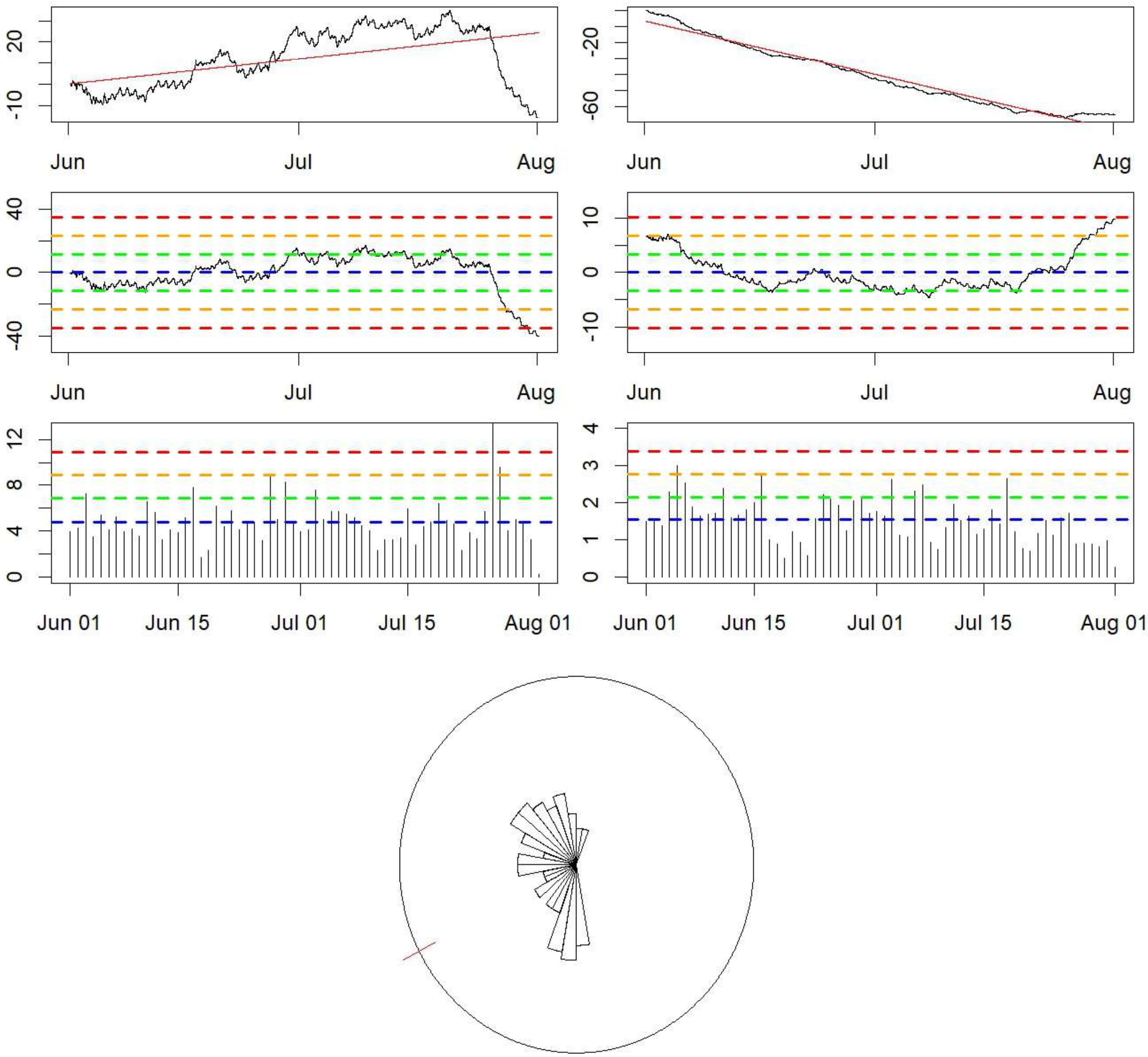
north: -383.73±0.24 ur/year SSD18 (ur) dist: 442 m east: 17.99±0.65 ur/year





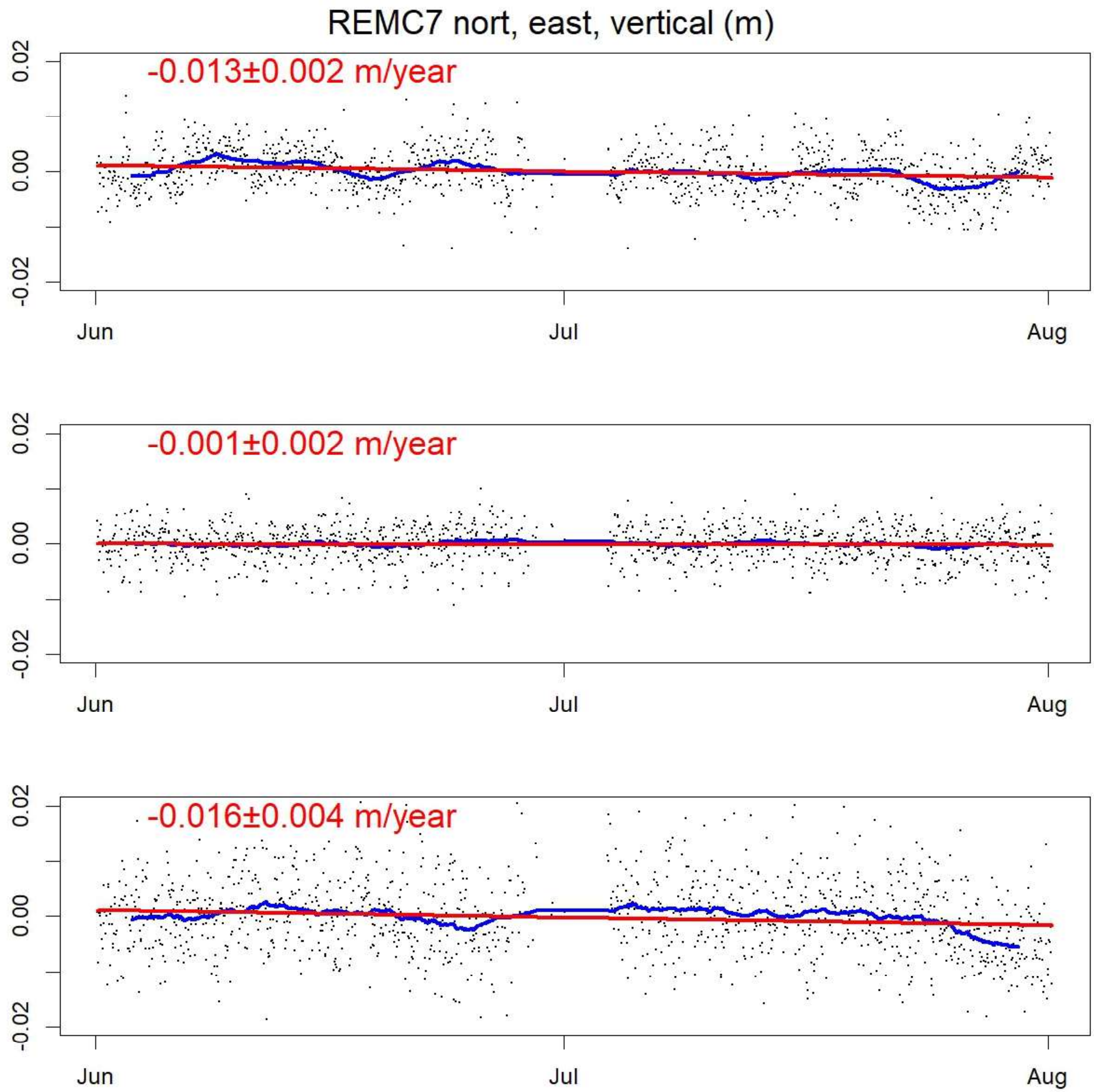
north: -15.12±0.35 ur/year
SSD19 (ur) dist: 689 m
east: 319.34±0.19 ur/year
Jun
Jul
Aug
Jun 01
Jun 15
Jul 01
Jul 15
Aug 01

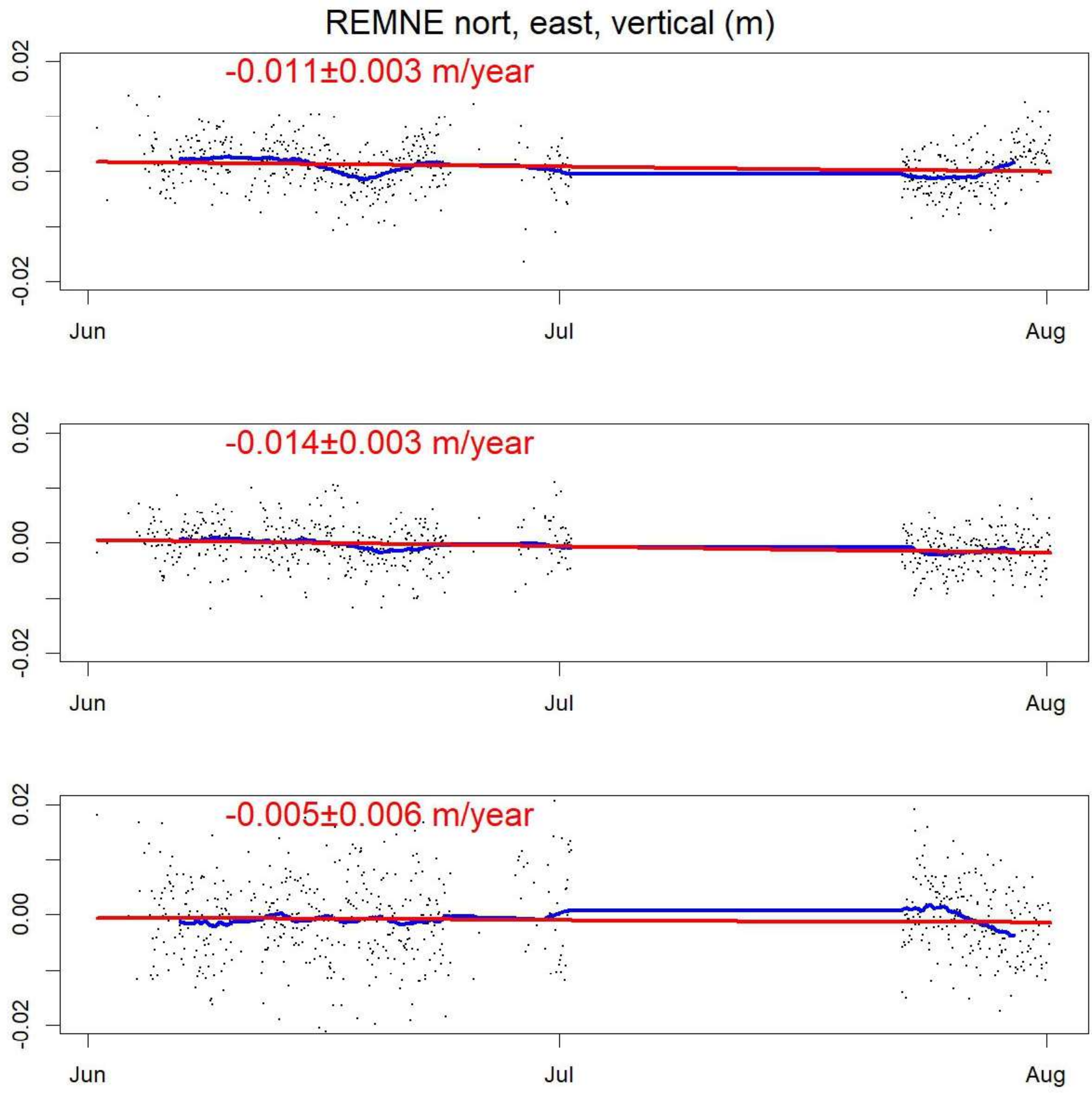
north: 145.28±1.65 ur/year SSD20 (ur) dist: 415 m east: -408.8±0.48 ur/year

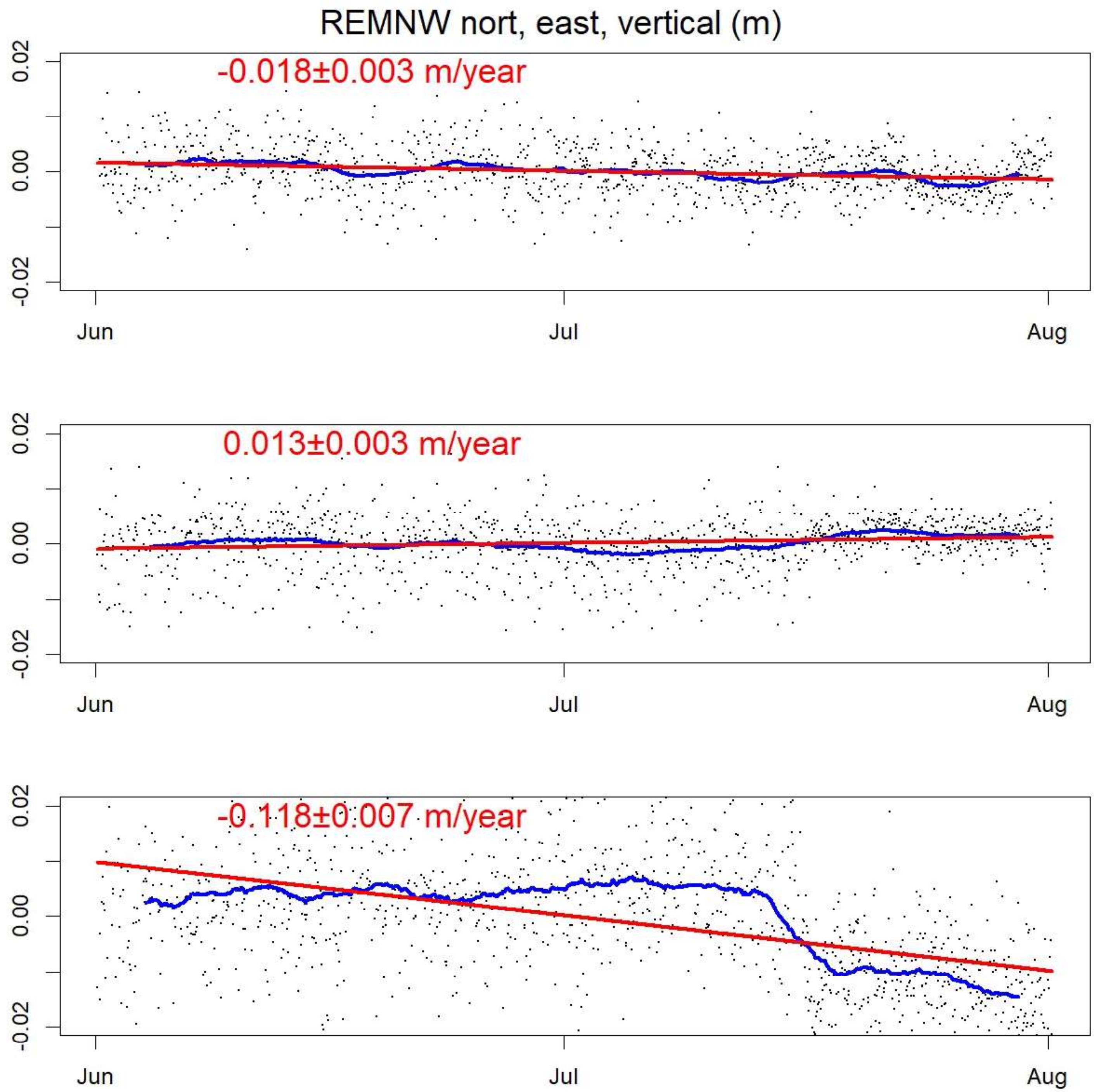


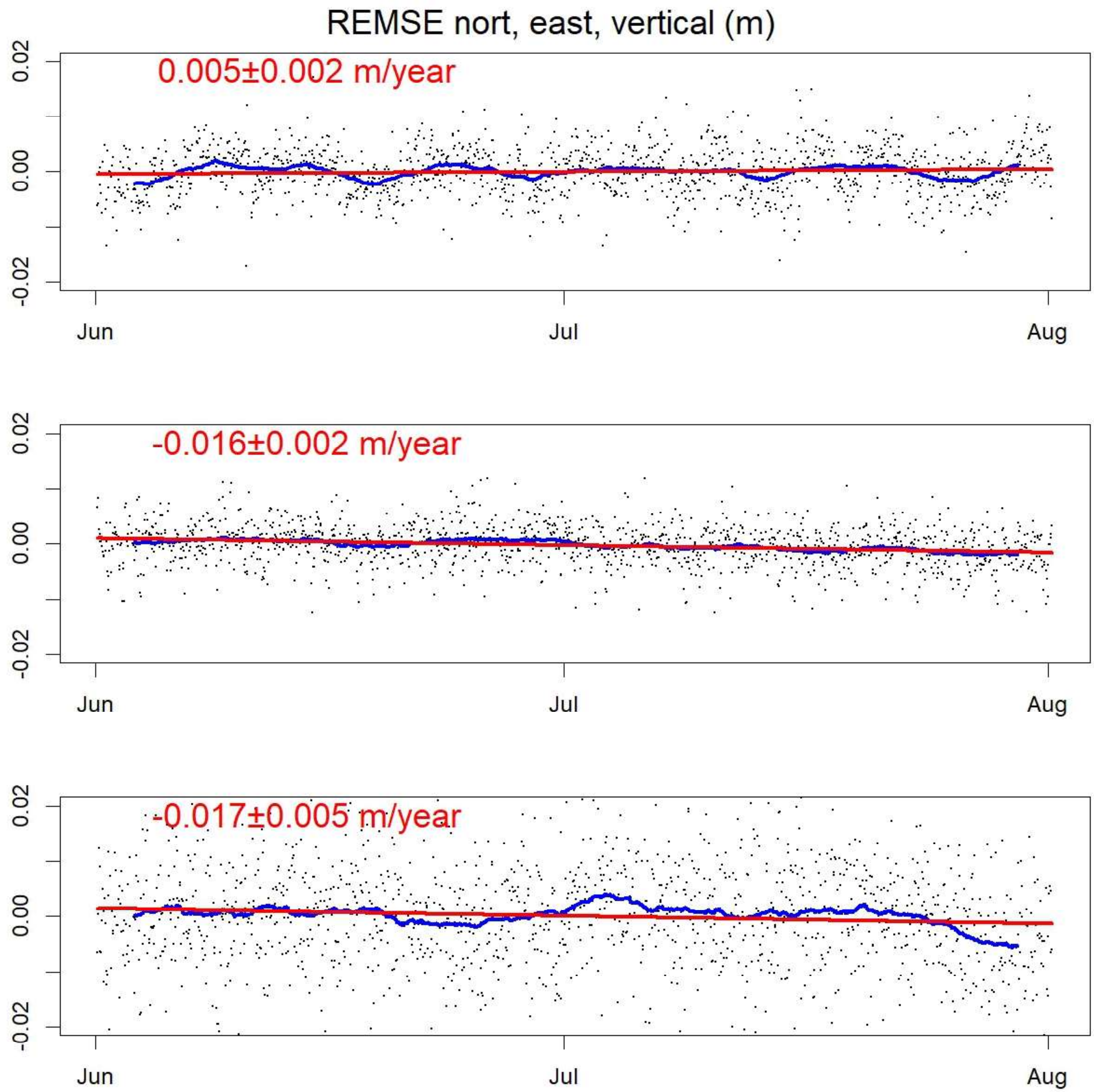
APPENDIX 2

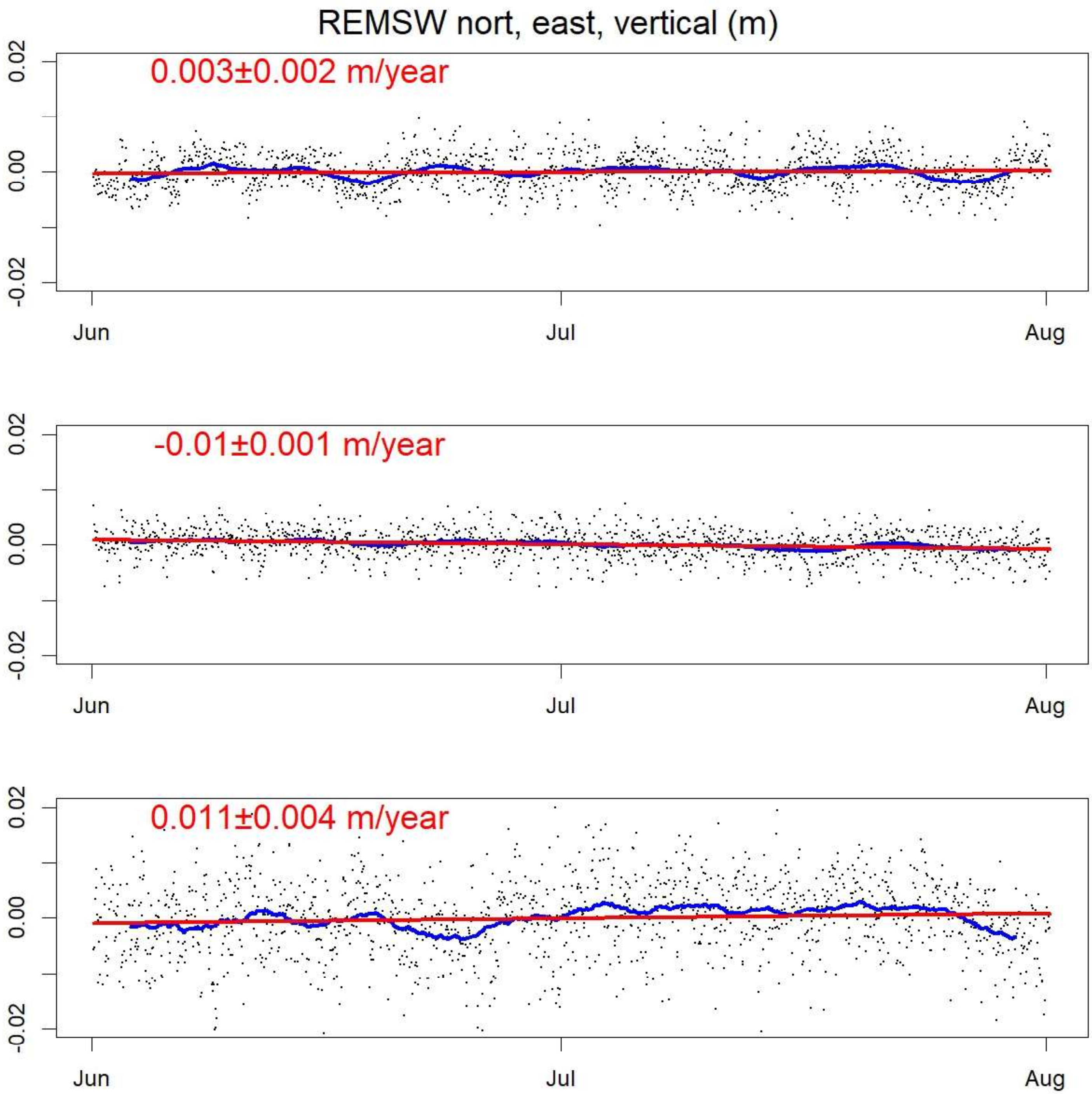
GNSS Data Plots - June-July 2024


REMC7 nort, east, vertical (m)
-0.013±0.002 m/year
-0.001±0.002 m/year
-0.016±0.004 m/year
0.02
0.00
-0.02
Jun
Jul
Aug


REMNE nort, east, vertical (m)
-0.011±0.003 m/year
0.02
0.00
-0.02
Jun
Jul
Aug
-0.014±0.003 m/year
0.02
0.00
-0.02
Jun
Jul
Aug
-0.005±0.006 m/year
0.02
0.00
-0.02
Jun
Jul
Aug


REMNW nort, east, vertical (m)
-0.018±0.003 m/year
0.02
0.00
-0.02
Jun
Jul
Aug
0.013±0.003 m/year
0.02
0.00
-0.02
Jun
Jul
Aug
-0.118±0.007 m/year
0.02
0.00
-0.02
Jun
Jul
Aug


REMSE nort, east, vertical (m)
0.005±0.002 m/year
-0.016±0.002 m/year
-0.017±0.005 m/year
0.02
0.00
-0.02
Jun
Jul
Aug


REMSW nort, east, vertical (m)
0.003±0.002 m/year
-0.01±0.001 m/year
0.011±0.004 m/year
0.02
0.00
-0.02
Jun
Jul
Aug

ATTACHMENT B

SNT InSAR report - July 30, 2024

SNT Satellite Update

Continuous InSAR Monitoring of
Ground Displacement At Westlake Caverns
and Western Dome Flank

Sulphur Mines Salt Dome

Prepared for:
Westlake Chemical

Prepared by:
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Dataset
Satellite Source
Sentinel-1 (SNT)
Most Recent Image Date
Tuesday, July 30, 2024

Analysis Report Date:

August 6, 2024

Dataset Information

Satellite Source	Sentinel-1 (SNT)
Revisit Frequency	12 days
Most Recent Image Date	Tuesday, July 30, 2024
Dataset Image Count	206
Dataset Time Range	October 4, 2016 - July 30, 2024
Dataset Length	7.82 Years
Satellite Line-of-Sight (LOS)	43° West of Vertical (Viewing site from the West)

Analysis Methodology

Time Series Charts

Trend lines were calculated for the averaged displacement values within each AOI. Quadratic regression was used to determine Velocity and Acceleration of LOS displacement. Trends calculated for the AOI point groups are depicted for each AOI in the Time Series section of this report.

Contour Maps

A quadratic trend was also calculated for each individual measurement point across the analysis region. Trend values for each point were used to generate Velocity and Acceleration contour maps to depict the spatial distribution of the movement trends. Negative velocity values indicate subsidence or eastward movement. Negative acceleration values indicate increasing rates of subsidence or eastward movement and positive acceleration values indicate slowing rates of subsidence or eastward movement.

Recent vs. Historical Data

The multi-year SNT dataset timeframe allows for Recent data to be evaluated separately from Historical data and for trends from the two timeframes to be compared. The change in the velocities and accelerations from the two timeframes are provided in the Time Series and Contour Map sections. Velocity values are calculated for the final date in either the Recent or Historical datasets.

Observations

To-date there have been no acute deviations from established subsidence trends in the areas investigated.

The comparison of Recent to Historical trends in the SNT data does not show any material increases (≥ -0.10) in the negative velocity and/or negative acceleration of LOS displacement in any of the 15 AOI point groups. This suggests that subsidence rates have not increased over the past two years relative to the historical data that has been collected since October 2016.

The mapped contours of the change in recent vs. historical subsidence velocity and acceleration mostly display minor fluctuations around 0, intermittently distributed withing the AOIs. This observation suggests that statistically relevant areas of change are not currently evident within the rate change maps.

Date Signed: August 6, 2024
Austin, Texas

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InSAR Data Sources

InSAR Data

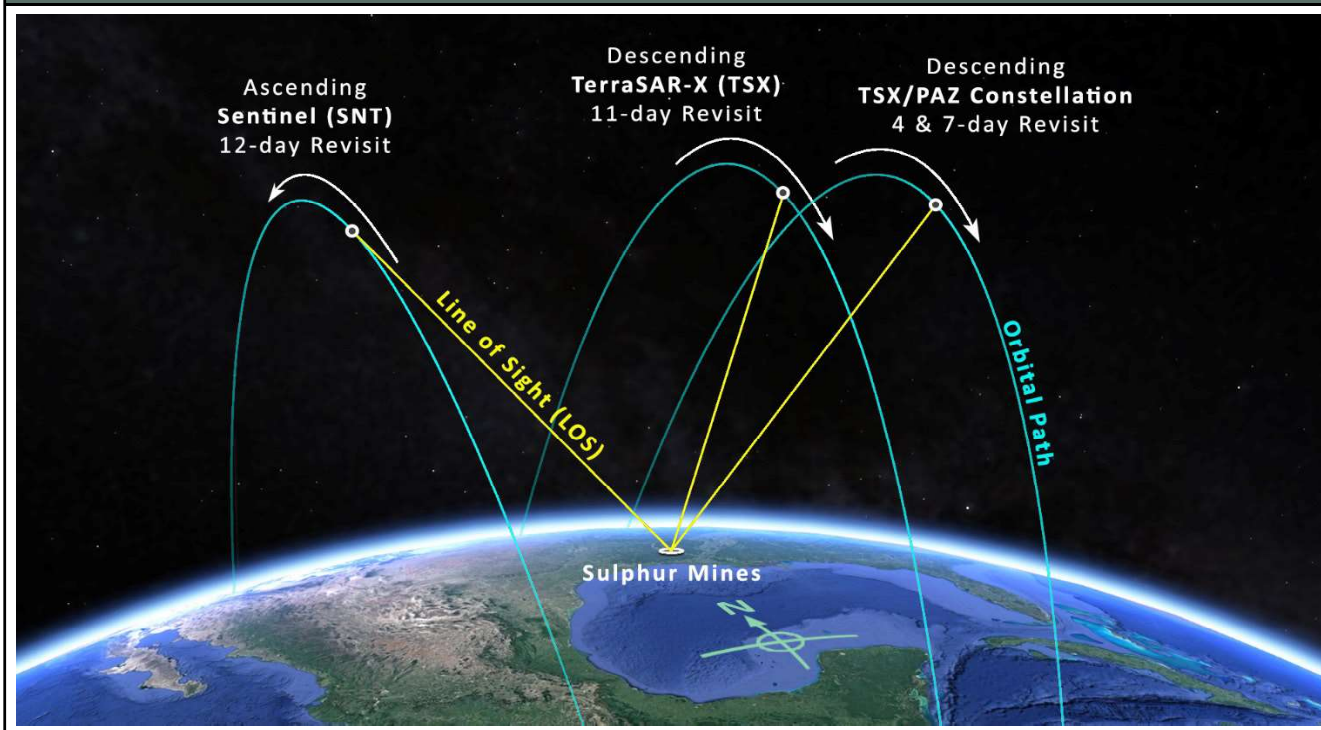
Interferometric Synthetic Aperture Radar (InSAR) is the most well established method to continually evaluate small, normally undetectable, ground movement over a large area. Radar imagery collected via satellites over successive orbital passes is used to identify and define measurement points on the ground. Objects or ground features providing a stable reflection of radar energy such as buildings, roads, and infrastructure produce the highest quality measurement points. InSAR analysis identifies the change in distance between the satellite and each measurement point over time relative to a stable reference point within the imaged area.

Satellite Sources

Two InSAR datasets are being used to evaluate subsidence over the Sulphur Mines Salt Dome. These datasets provide Line-of-Sight (LOS) displacment measurements from both ascending and descending orbits. An ascending orbit denotes the satellite's longitudinal course from south to north as it passes over the site, while a desceding orbit denotes the satellite is moving from north to south.

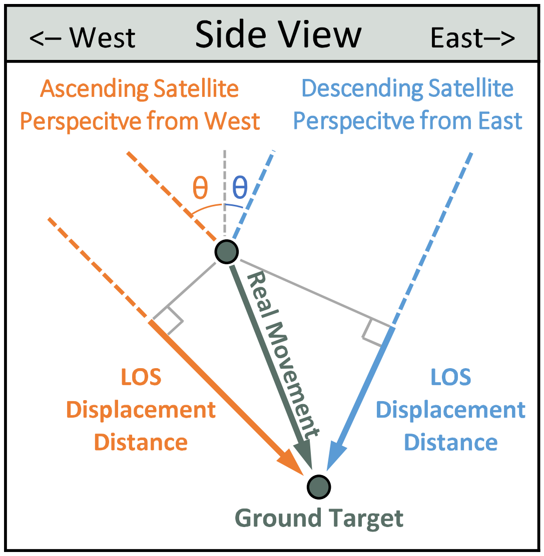
The first dataset comes from a low-resolution Sentinel-1 (SNT) satellite on an ascending orbit that captures data from the west of the site on a 12-day frequency. The second comes from a pair of high resolution satellites that share the same descending orbit and capture data from east of the site. These are a TSX satellite and the PAZ satellite (TSX/PAZ constellation), both with an 11-day revisit frequency. Their orbits are offset with the PAZ satellite passing over the site 4 days after the TSX satellite. Prior to May 2023, data was captured from a different high-resolution TerraSAR-X (TSX) satellite on a descending orbit that captured data from the east of the site on an 11-day frequency. The transition was made for the increased data frequency that resulted from a 4 and 7-day revisit period. The image below depicts the orbital paths of the satellites in relation to the Sulphur Mines Salt Dome.

Satellite Orbital Diagram



InSAR Line-of-Site (LOS) Data

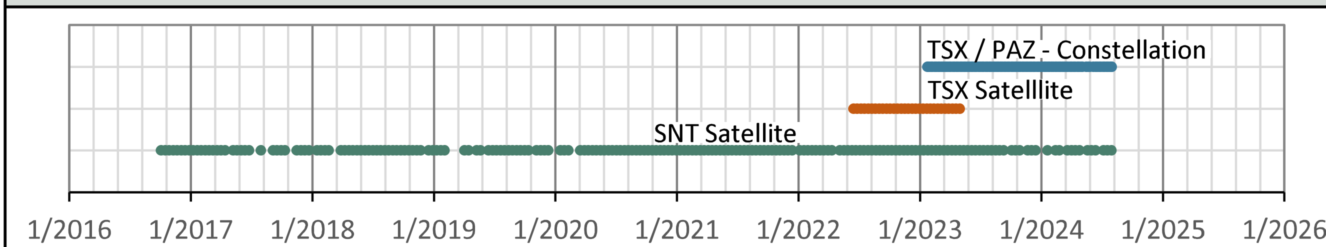
LOS displacement measurements refer to a change in distance between the satellite sensor and the ground target. Measurement positions on the west side of the Sulphur Dome are are known to be experiencing some eastward movement toward the dome center due to the geometry of the subsidence basin. The InSAR satellites view the site from eastward and westward positions so LOS measurements are understood to convey a movement distance that is not purely vertical. The diagram to the right illustrates the geometric relationship between the theoretical Real movement of a ground target and LOS displacement measurements from two different satellite viewing directions.



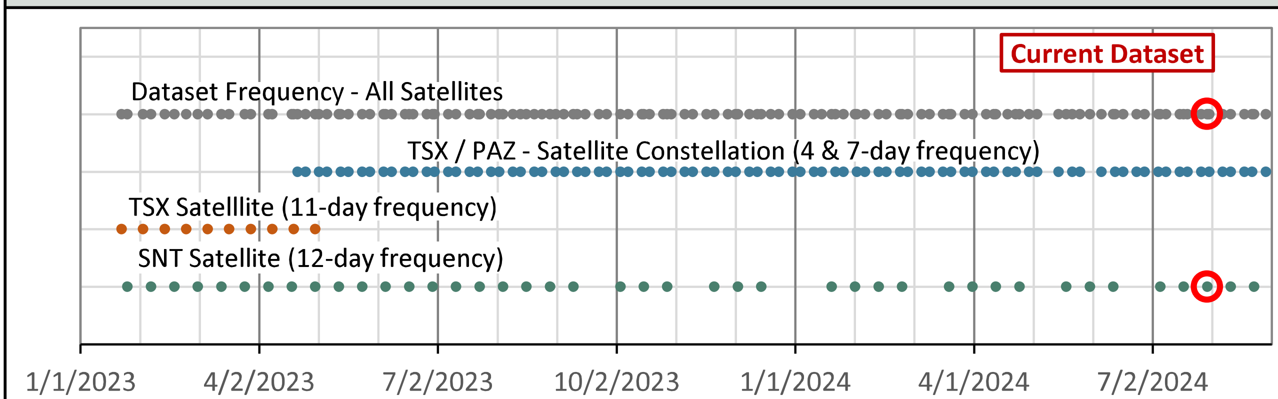
Satellite Properties & Image Frequency

Satellite and Data Properties	SNT	TSX	TSX/PAZ Constellation
Band (Wavelength)	C-band (2.20 in)	X-band (1.22 in)	X-band (1.22 in)
Track	T136	T29	T67 & T120
Pixel resolution	65 x 16 ft	3 x 3 ft	3 x 3 ft
Revisit frequency	12 days	11 days	4 & 7 days
Orbit (LOS Angle, θ)	Ascending (43°)	Descending (17°)	Descending (37°)
Data Start Date	10/4/2016	6/16/2022	1/24/2023
Measurement error range	± 0.20 in	± 0.03 in	± 0.03 in

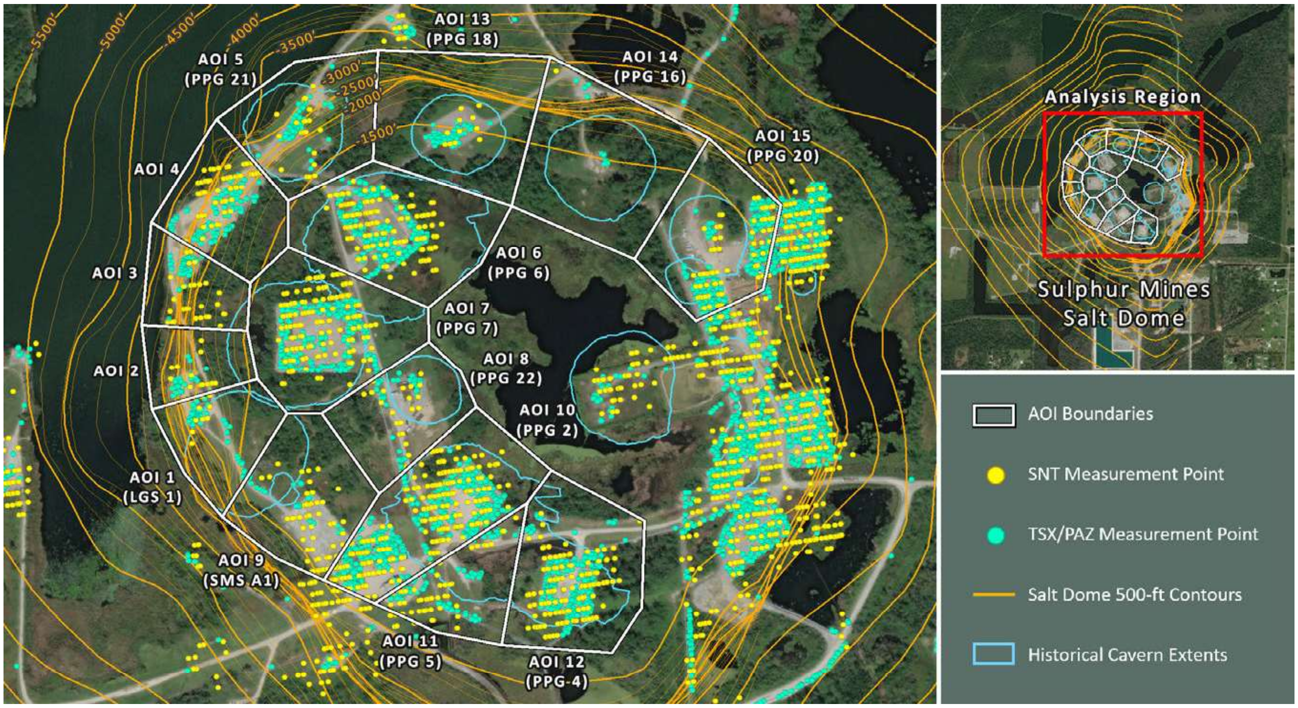
Dataset Measurement History



Dataset Update Frequency



AOI Boundaries & InSAR Measurement Points

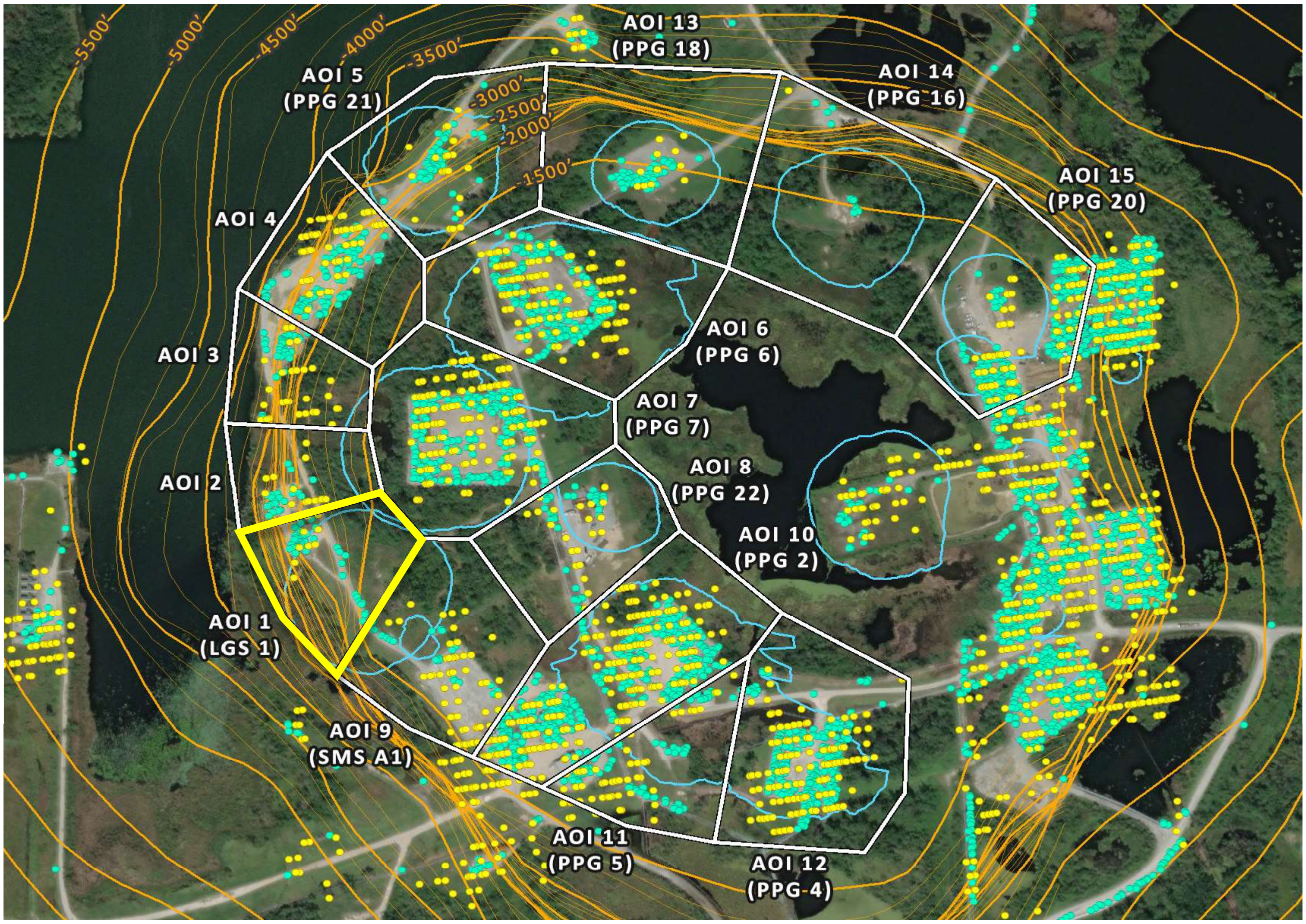


Subsidence Monitoring Areas of Interest (AOIs)

To visually convey and evaluate trend consistency for the displacement time series of each ground target, measurment points were grouped and their displacement values were averaged. The point groups are referred to as Areas of Interest (AOIs) in this analysis and their boundaries are depicted on the above map. The below table lists the trend values calculated in each AOI for the dataset evaluated in this report.

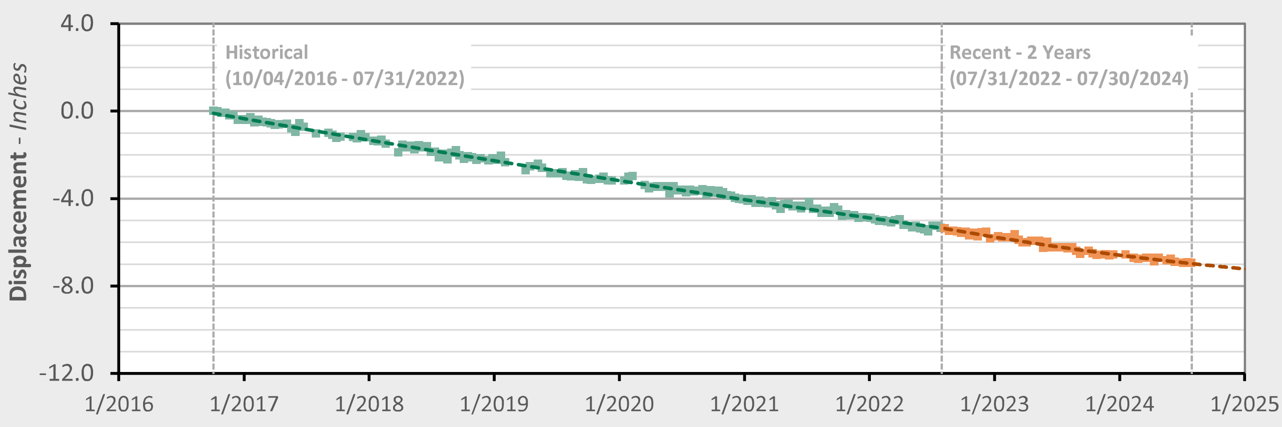
AOI Name	SNT (7/30/2024)	LOS Velocity *(in/yr)*			LOS Acceleration *(in/yr^2)*		
	Point Count	Historical	Recent	Change	Historical	Recent	Change
AOI 1 *(LGS 1)*	13	-0.79	-0.61	+0.18	+0.04	+0.20	+0.16
AOI 2	15	-0.79	-0.82	-0.03	+0.06	+0.06	+0.00
AOI 3	29	-0.66	-0.56	+0.11	+0.03	+0.12	+0.10
AOI 4	61	-0.76	-0.66	+0.11	+0.00	+0.03	+0.03
AOI 5 *(PPG 21)*	26	-0.66	-0.52	+0.14	+0.02	+0.02	+0.01
AOI 6 *(PPG 6)*	134	-0.87	-0.79	+0.08	+0.05	+0.07	+0.02
AOI 7 *(PPG 7)*	140	-0.99	-0.96	+0.03	+0.07	+0.12	+0.05
AOI 8 *(PPG 22)*	20	-1.06	-1.08	-0.01	+0.11	+0.17	+0.06
AOI 9 *(SMS A1)*	58	-0.85	-0.70	+0.15	+0.08	+0.16	+0.08
AOI 10 *(PPG 2)*	232	-0.91	-0.94	-0.04	+0.09	+0.05	-0.04
AOI 11 *(PPG 5)*	53	-0.90	-0.76	+0.14	+0.06	+0.14	+0.08
AOI 12 *(PPG 4)*	120	-0.74	-0.38	+0.35	+0.05	+0.34	+0.29
AOI 13 *(PPG 18)*	12	-0.60	-0.47	+0.13	+0.04	+0.12	+0.08
AOI 14 *(PPG 16)*	1	-0.23	-0.00	+0.22	+0.06	+0.50	+0.44
AOI 15 *(PPG 20)*	71	-0.28	-0.20	+0.09	+0.05	+0.08	+0.03

AOI 1 *(LGS 1)* - Location Map



AOI 1 *(LGS 1)* - Displacement Time Series

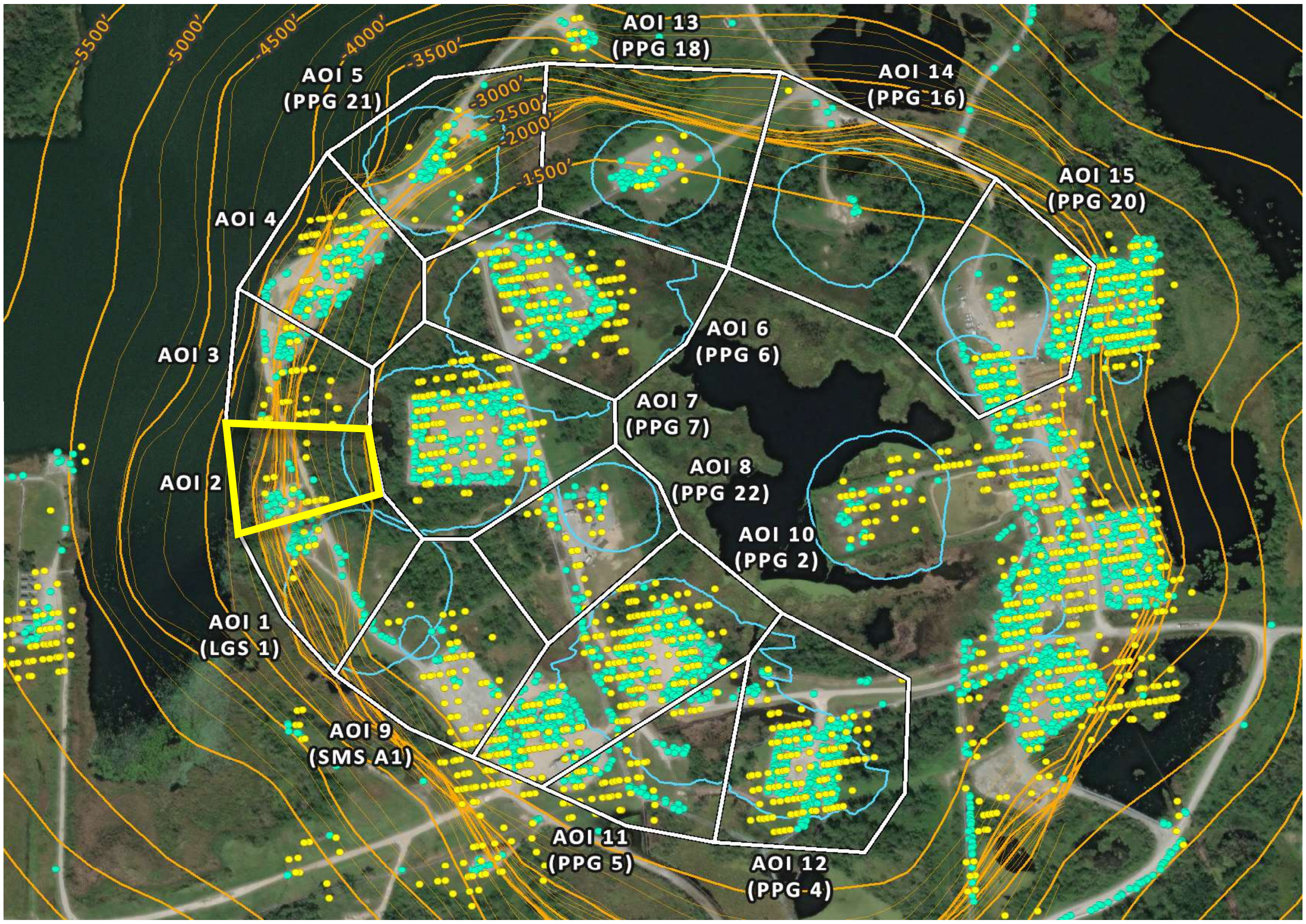
SNT (7/30/2024) Point Count: **13**



	Historical Trend Values	Recent Trend Values	Trend Change
Velocity:	-0.79 in/yr	-0.61 in/yr	+0.18 in/yr
Acceleration:	+0.04 in/yr^2	+0.20 in/yr^2	+0.16 in/yr^2

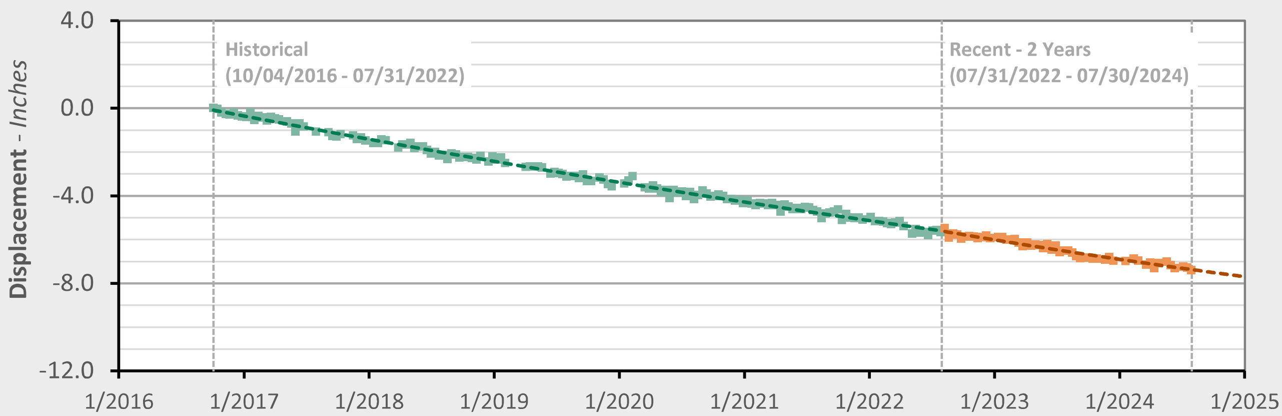
Historical LOS Displacement Measurement; Historical Trend Line (Quadratic Regression); Recent LOS Displacement Measurement; Historical Trend Line (Quadratic Regression)

AOI 2 - Location Map



AOI 2 - Displacement Time Series

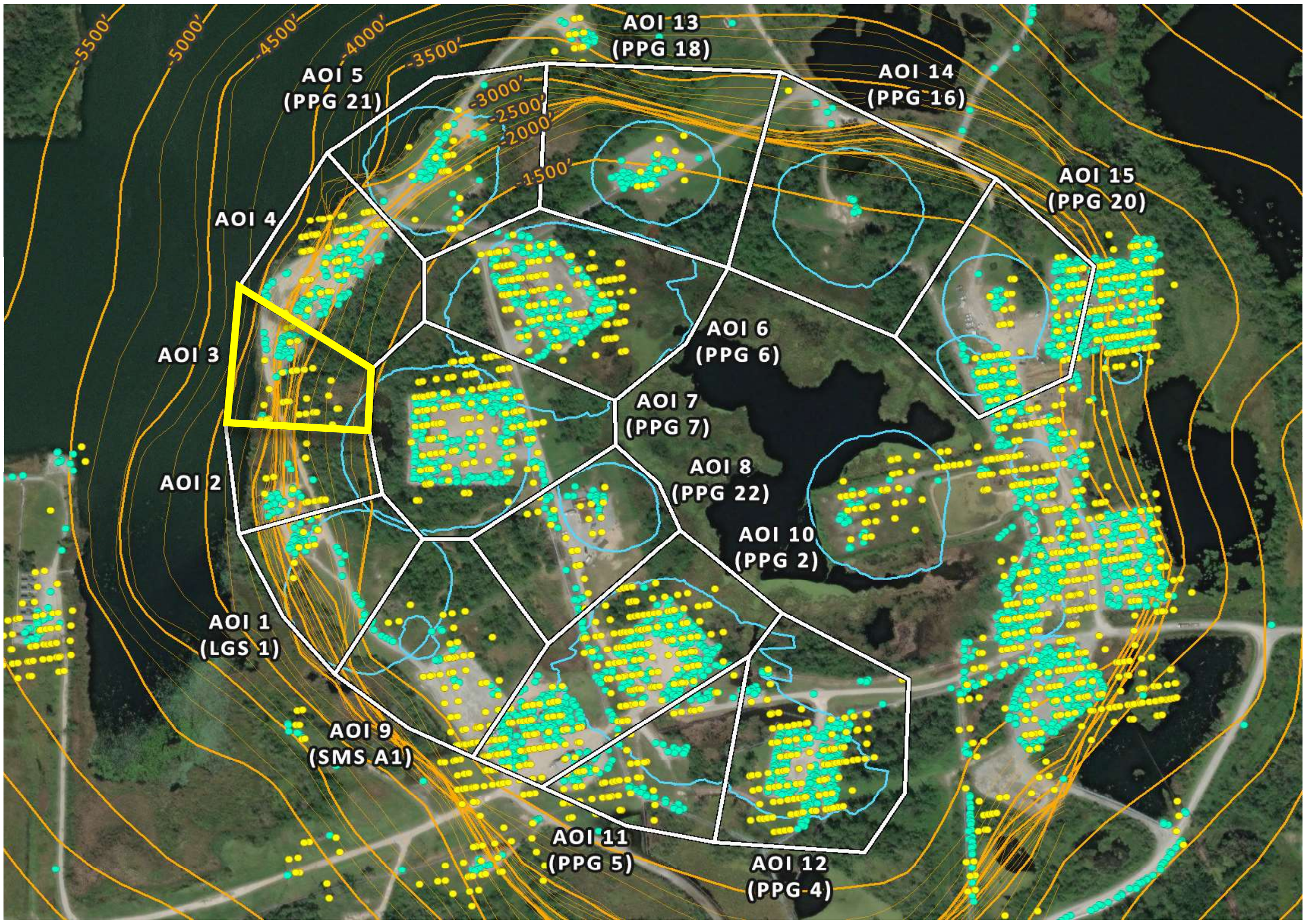
SNT (7/30/2024) Point Count: **15**



	Historical Trend Values	Recent Trend Values	Trend Change
Velocity:	-0.79 in/yr	-0.82 in/yr	-0.03 in/yr
Acceleration:	+0.06 in/yr^2	+0.06 in/yr^2	+0.00 in/yr^2

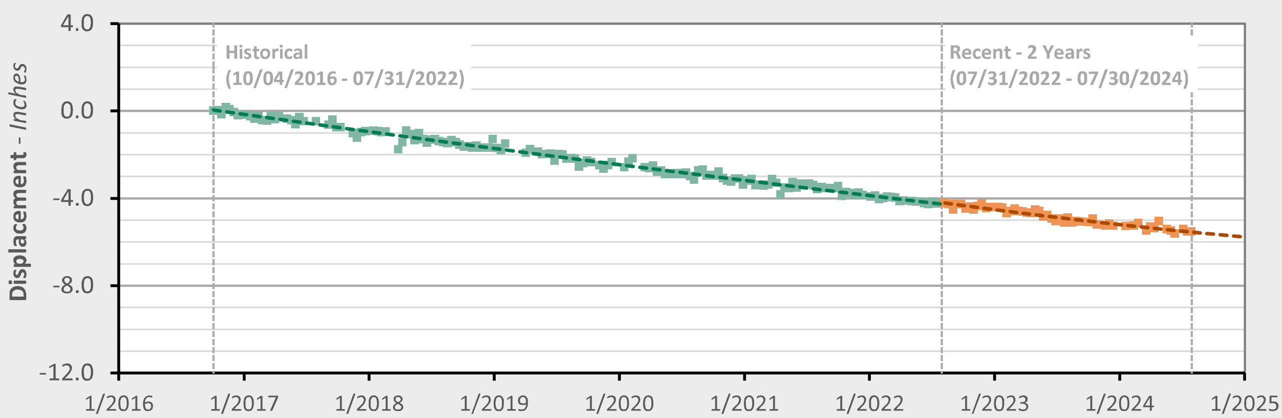
Historical LOS Displacement Measurement — Historical Trend Line (Quadratic Regression) — Recent LOS Displacement Measurement — Historical Trend Line (Quadratic Regression)

AOI 3 - Location Map



AOI 3 - Displacement Time Series

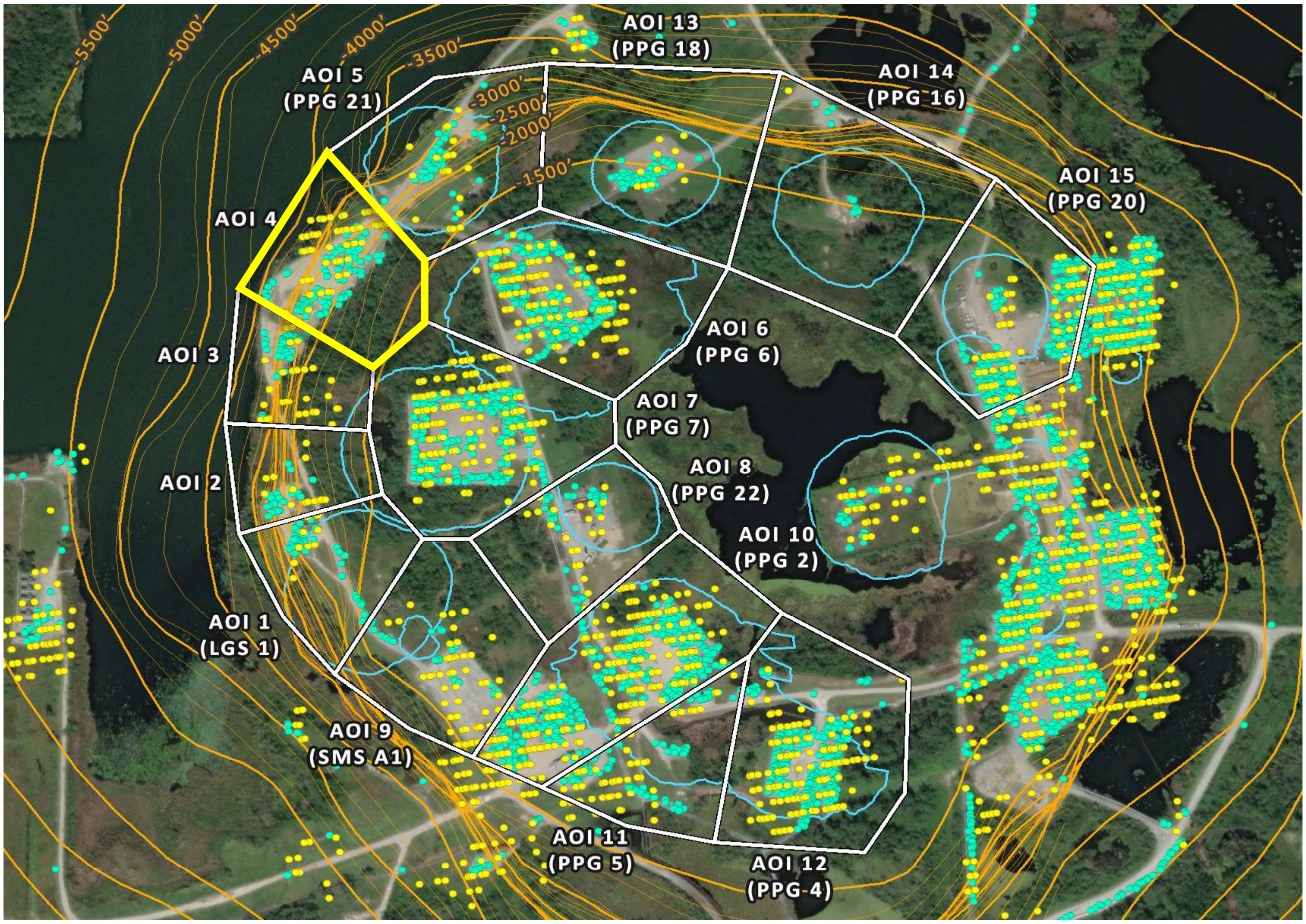
SNT (7/30/2024) Point Count: 29



	Historical Trend Values	Recent Trend Values	Trend Change
Velocity:	-0.66 in/yr	-0.56 in/yr	+0.11 in/yr
Acceleration:	+0.03 in/yr^2	+0.12 in/yr^2	+0.10 in/yr^2

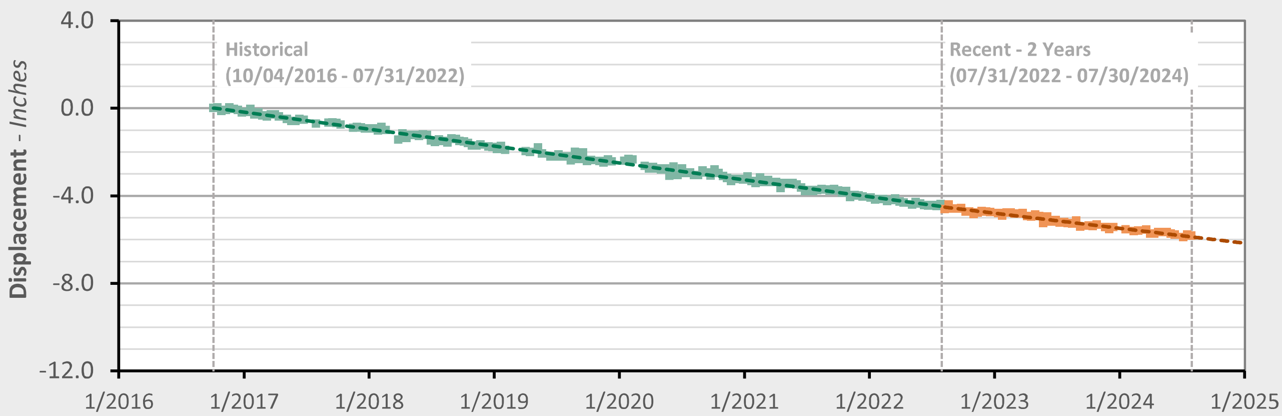
Historical LOS Displacement Measurement — Historical Trend Line (Quadratic Regression) — Recent LOS Displacement Measurement — Historical Trend Line (Quadratic Regression)

AOI 4 - Location Map



AOI 4 - Displacement Time Series

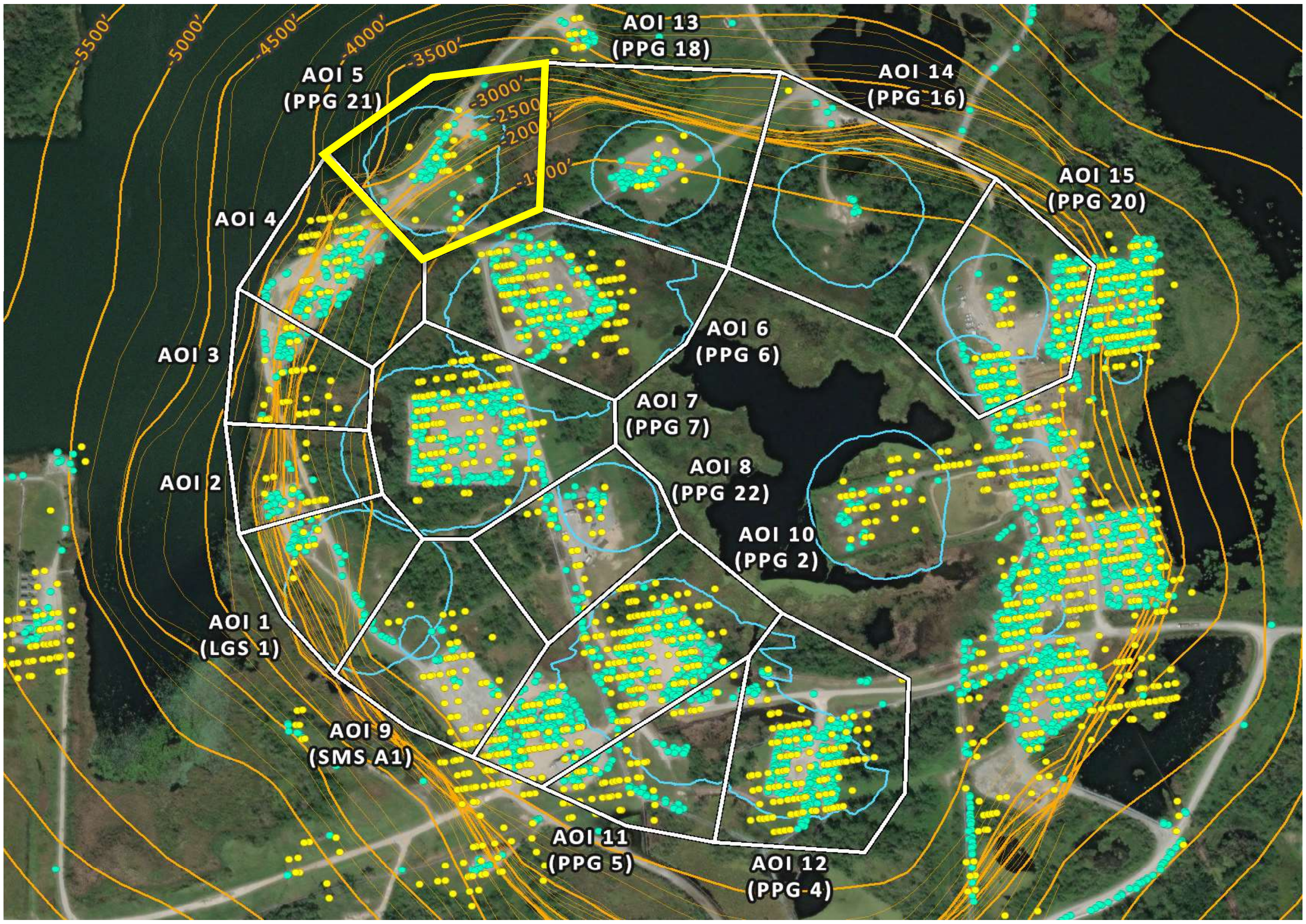
SNT (7/30/2024) Point Count: **61**



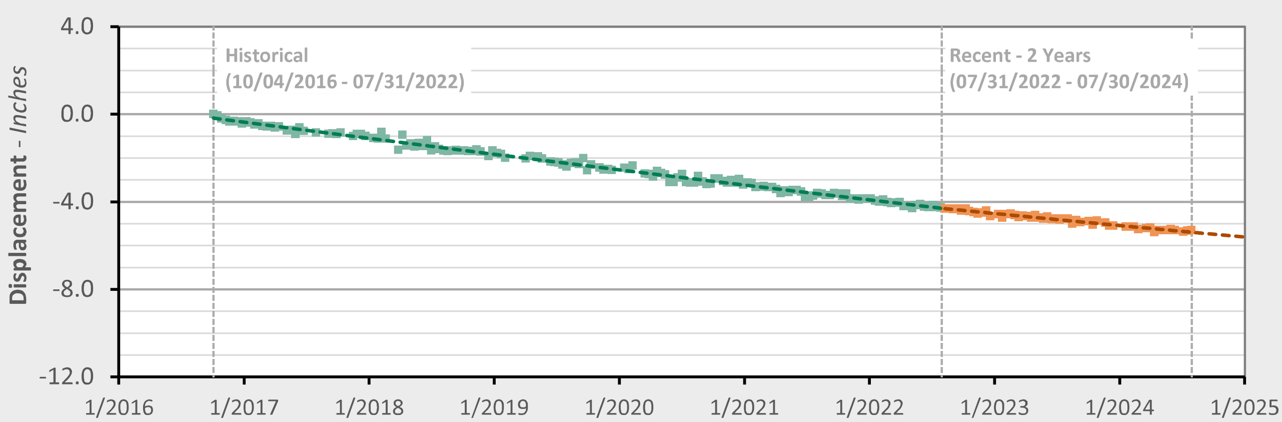
	Historical Trend Values	Recent Trend Values	Trend Change
Velocity:	-0.76 in/yr	-0.66 in/yr	+0.11 in/yr
Acceleration:	+0.00 in/yr^2	+0.03 in/yr^2	+0.03 in/yr^2

Historical LOS Displacement Measurement — Historical Trend Line (Quadratic Regression) — Recent LOS Displacement Measurement — Historical Trend Line (Quadratic Regression)

AOI 5 *(PPG 21)* - Location Map



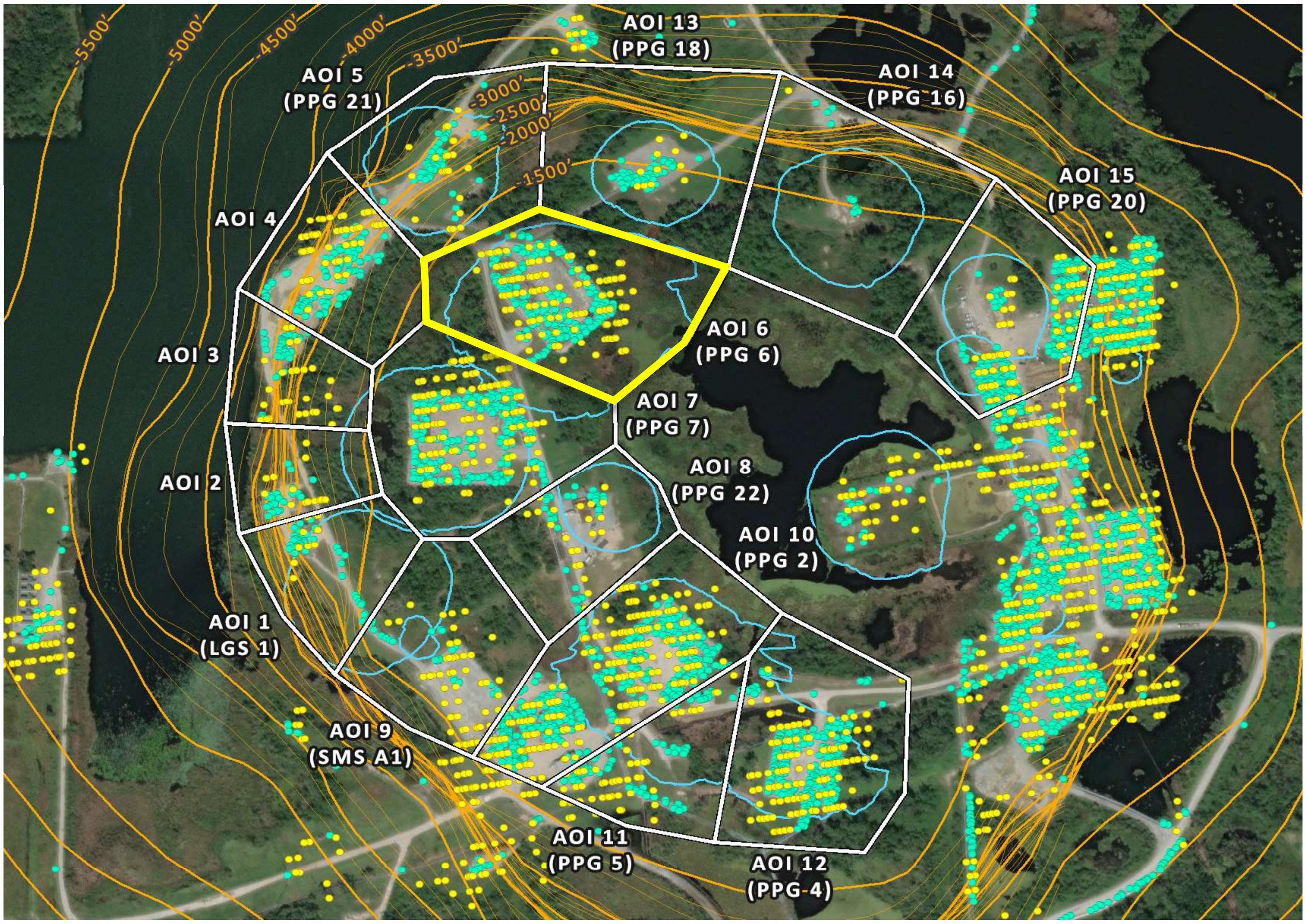
AOI 5 *(PPG 21)* - Displacement Time Series SNT (7/30/2024) Point Count: 26



	Historical Trend Values	Recent Trend Values	Trend Change
Velocity:	-0.66 in/yr	-0.52 in/yr	+0.14 in/yr
Acceleration:	+0.02 in/yr^2	+0.02 in/yr^2	+0.01 in/yr^2

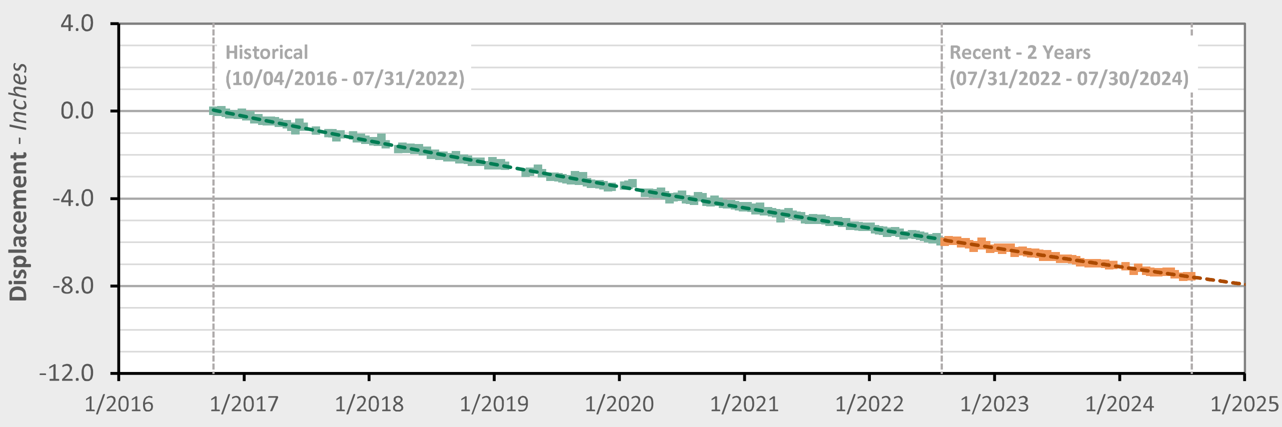
Historical LOS Displacement Measurement — Historical Trend Line (Quadratic Regression) — Recent LOS Displacement Measurement — Historical Trend Line (Quadratic Regression)

AOI 6 *(PPG 6)* - Location Map



AOI 6 *(PPG 6)* - Displacement Time Series

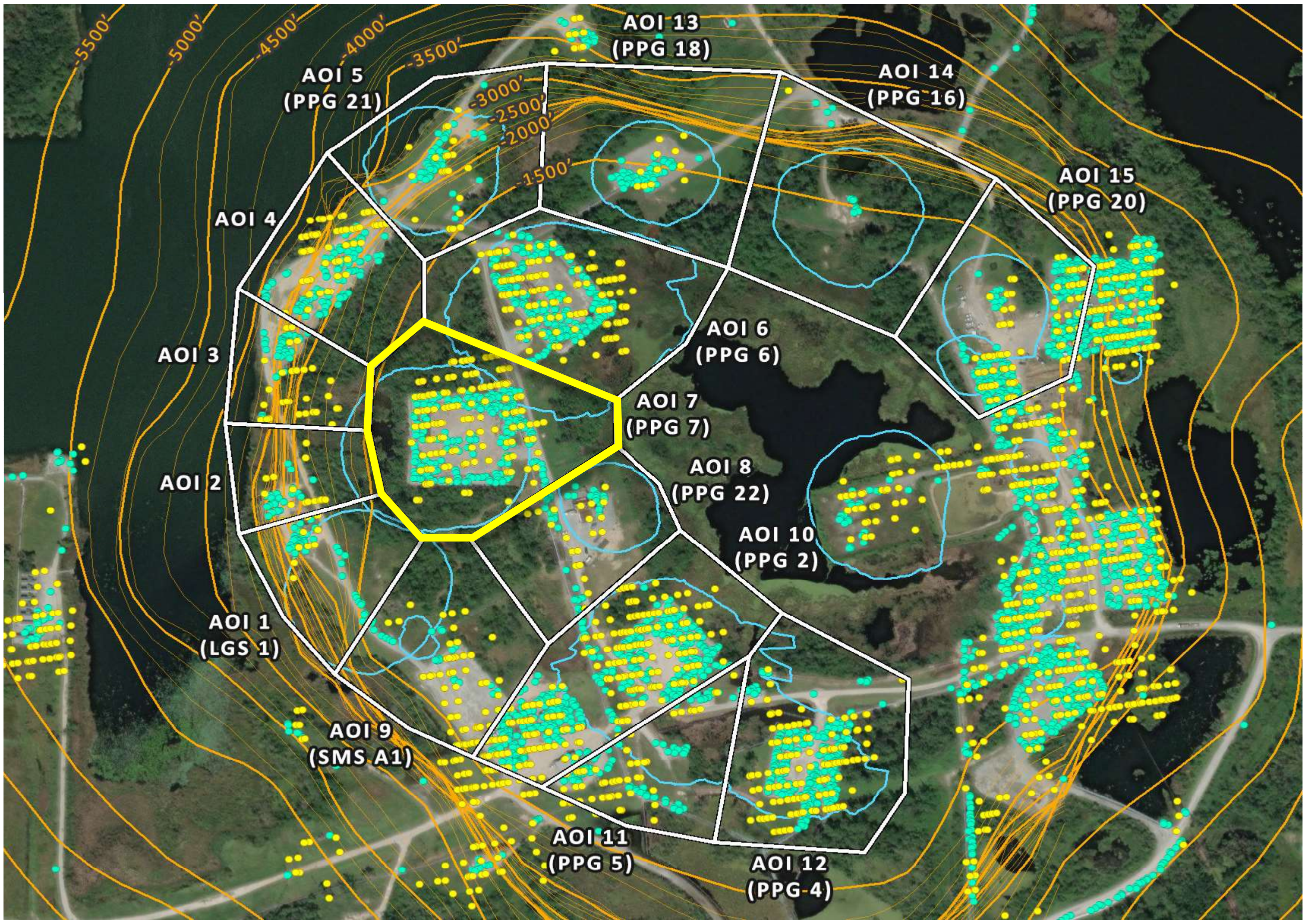
SNT (7/30/2024) Point Count: **134**



	Historical Trend Values	Recent Trend Values	Trend Change
Velocity:	-0.87 in/yr	-0.79 in/yr	+0.08 in/yr
Acceleration:	+0.05 in/yr^2	+0.07 in/yr^2	+0.02 in/yr^2

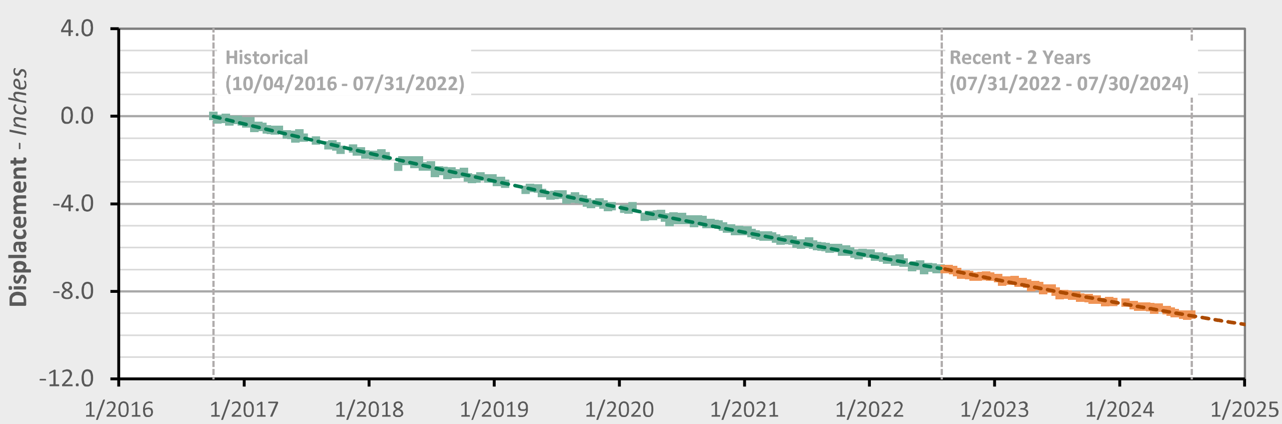
Historical LOS Displacement Measurement — Historical Trend Line (Quadratic Regression) — Recent LOS Displacement Measurement — Historical Trend Line (Quadratic Regression)

AOI 7 *(PPG 7)* - Location Map



AOI 7 *(PPG 7)* - Displacement Time Series

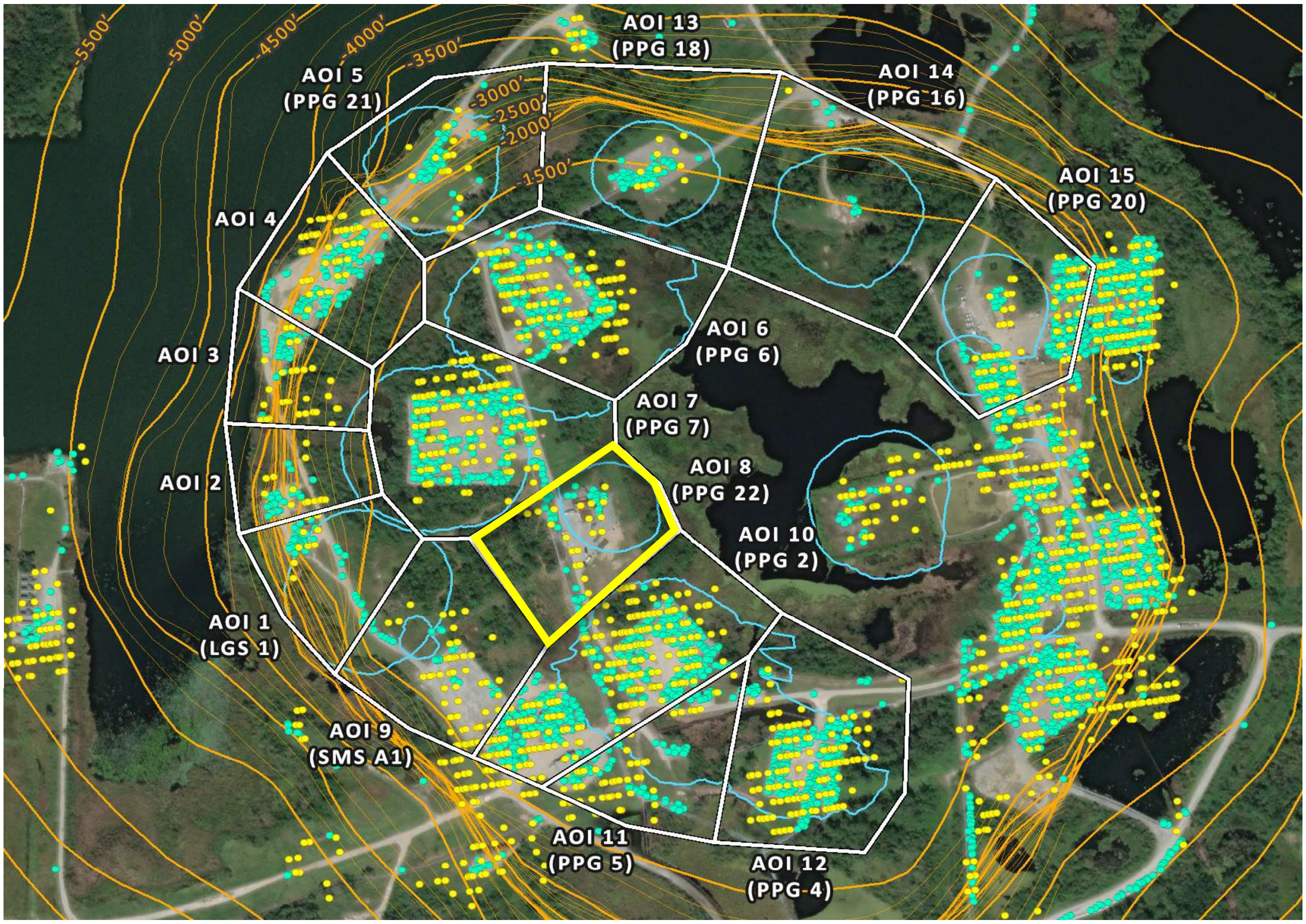
SNT (7/30/2024) Point Count: **140**



	Historical Trend Values	Recent Trend Values	Trend Change
Velocity:	-0.99 in/yr	-0.96 in/yr	+0.03 in/yr
Acceleration:	+0.07 in/yr^2	+0.12 in/yr^2	+0.05 in/yr^2

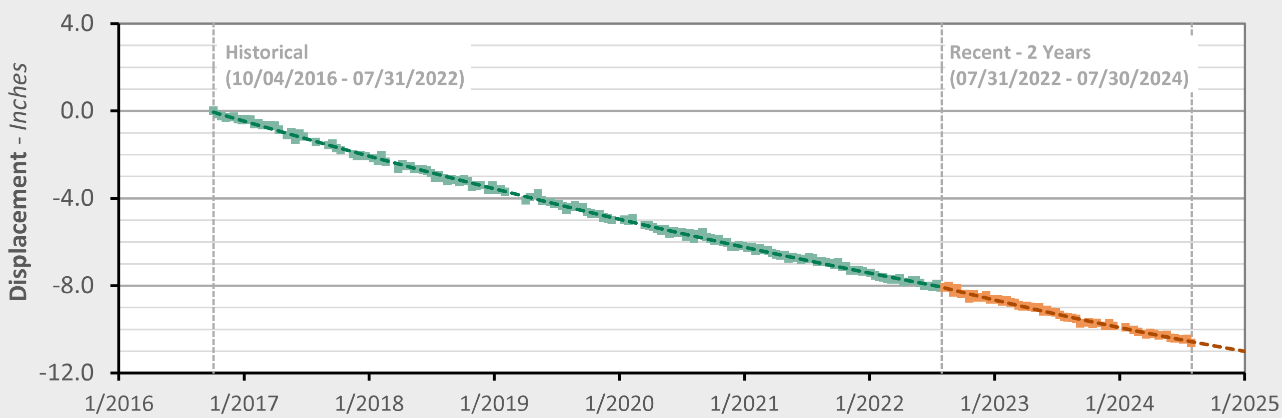
Historical LOS Displacement Measurement
Historical Trend Line (Quadratic Regression)
Recent LOS Displacement Measurement
Historical Trend Line (Quadratic Regression)

AOI 8 *(PPG 22)* - Location Map



AOI 8 *(PPG 22)* - Displacement Time Series

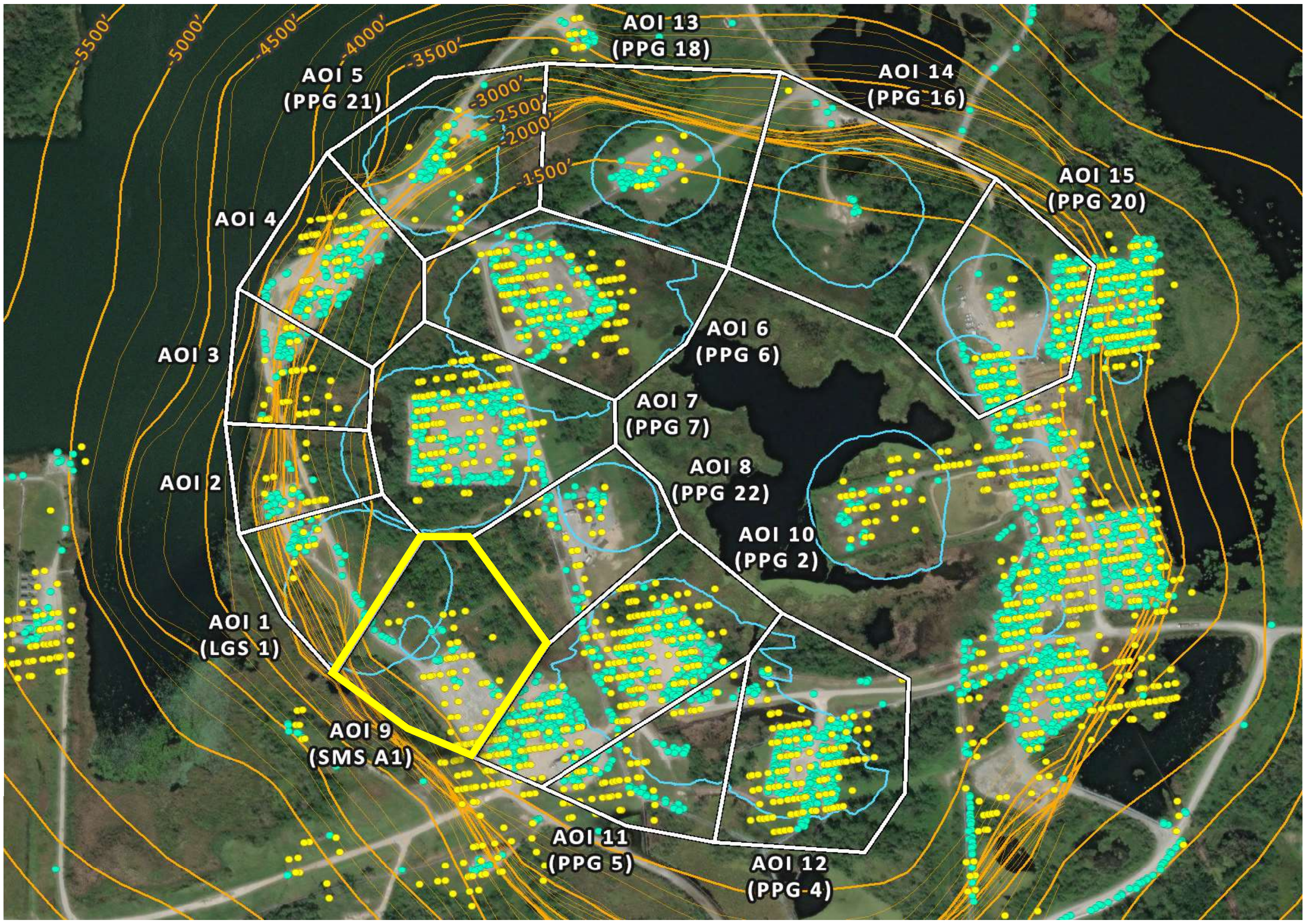
SNT (7/30/2024) Point Count: **20**



	Historical Trend Values	Recent Trend Values	Trend Change
Velocity:	-1.06 in/yr	-1.08 in/yr	-0.01 in/yr
Acceleration:	+0.11 in/yr²	+0.17 in/yr²	+0.06 in/yr²

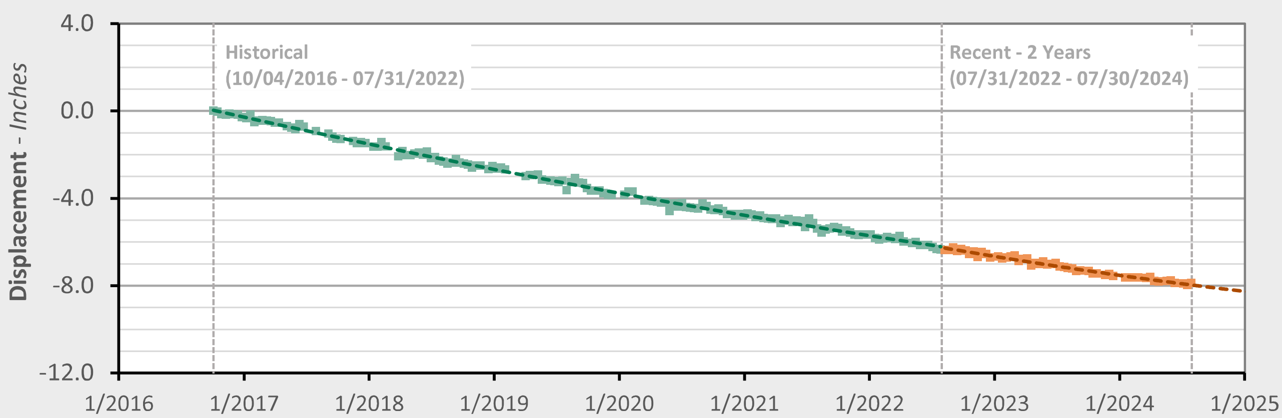
Historical LOS Displacement Measurement | Historical Trend Line (Quadratic Regression) | Recent LOS Displacement Measurement | Historical Trend Line (Quadratic Regression)

AOI 9 *(PPG A1)* - Location Map



AOI 9 *(SMS A1)* - Displacement Time Series

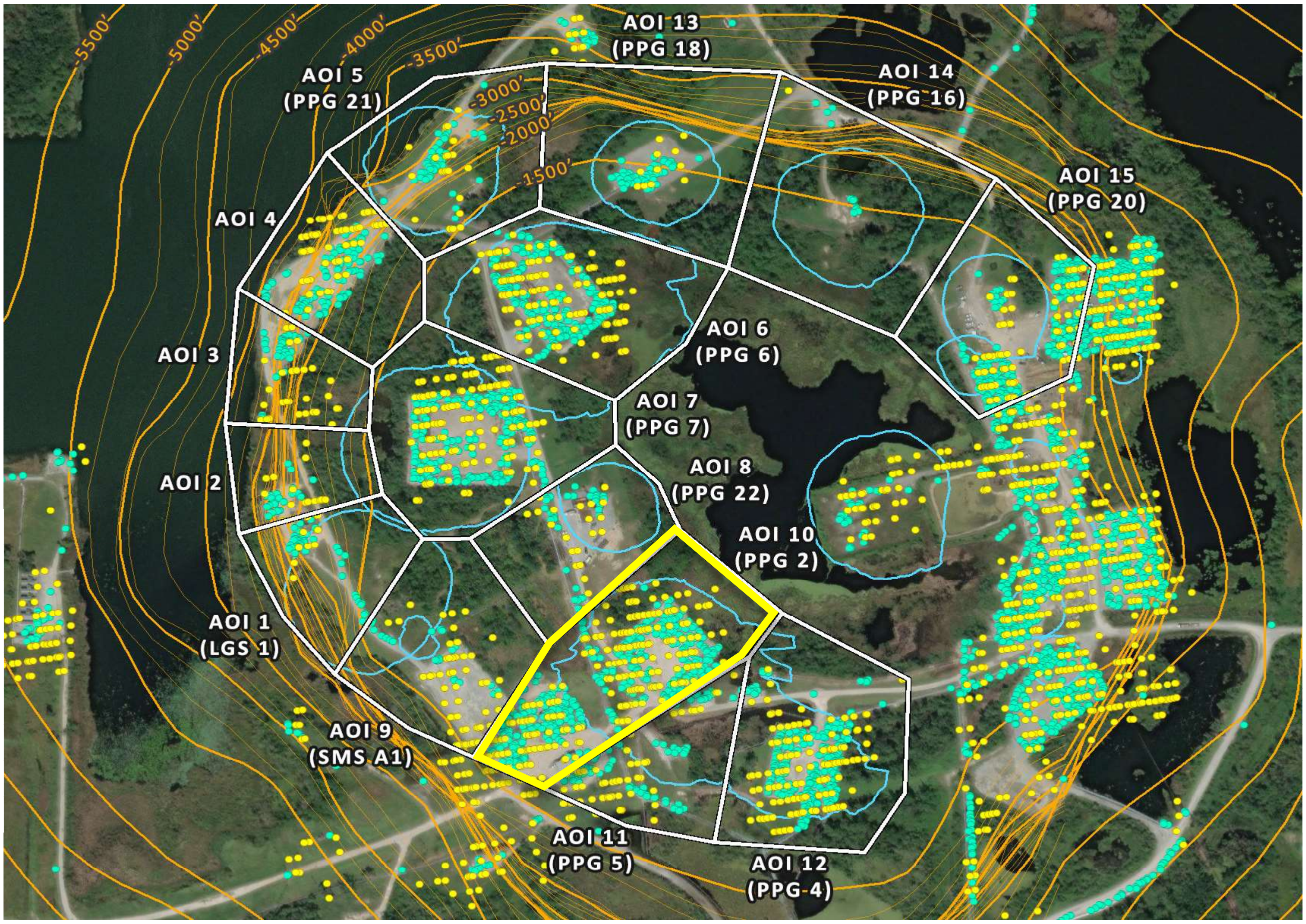
SNT (7/30/2024) Point Count: 58



	Historical Trend Values	Recent Trend Values	Trend Change
Velocity:	-0.85 in/yr	-0.70 in/yr	+0.15 in/yr
Acceleration:	+0.08 in/yr^2	+0.16 in/yr^2	+0.08 in/yr^2

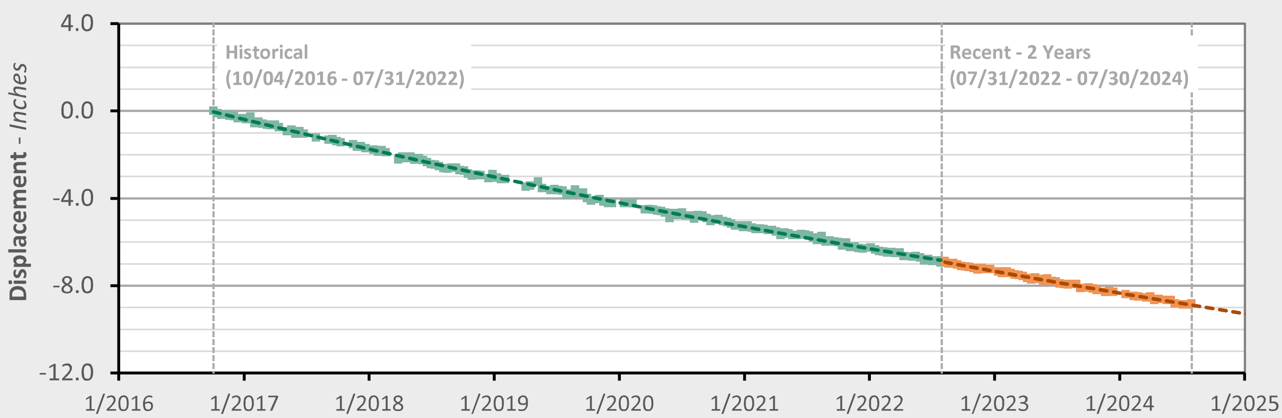
Historical LOS Displacement Measurement — Historical Trend Line (Quadratic Regression) — Recent LOS Displacement Measurement — Historical Trend Line (Quadratic Regression)

AOI 10 *(PPG 2)* - Location Map



AOI 10 *(PPG 2)* - Displacement Time Series

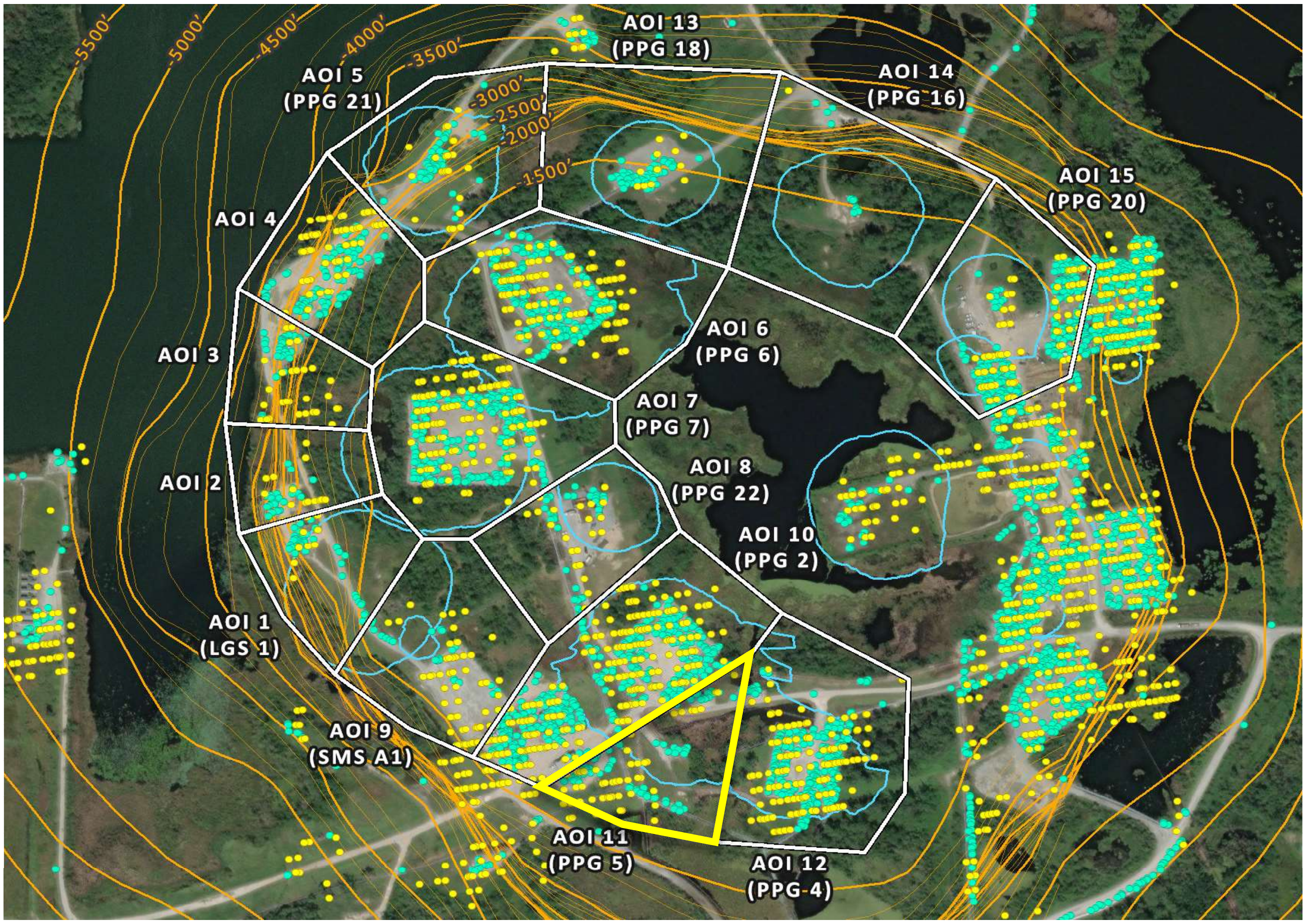
SNT (7/30/2024) Point Count: **232**



	Historical Trend Values	Recent Trend Values	Trend Change
Velocity:	-0.91 in/yr	-0.94 in/yr	-0.04 in/yr
Acceleration:	+0.09 in/yr^2	+0.05 in/yr^2	-0.04 in/yr^2

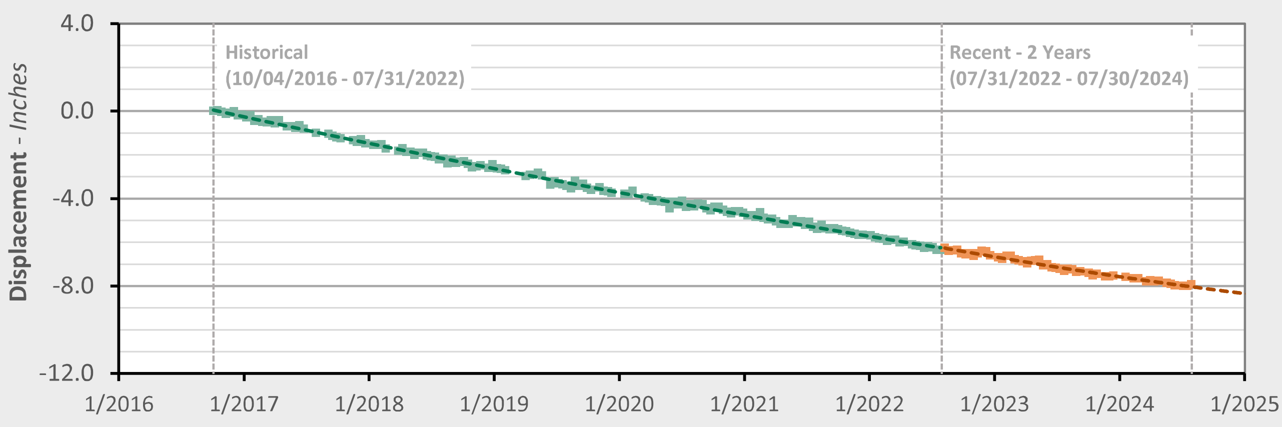
Historical LOS Displacement Measurement | Historical Trend Line (Quadratic Regression) | Recent LOS Displacement Measurement | Historical Trend Line (Quadratic Regression)

AOI 11 *(PPG 5)* - Location Map



AOI 11 *(PPG 5)* - Displacement Time Series

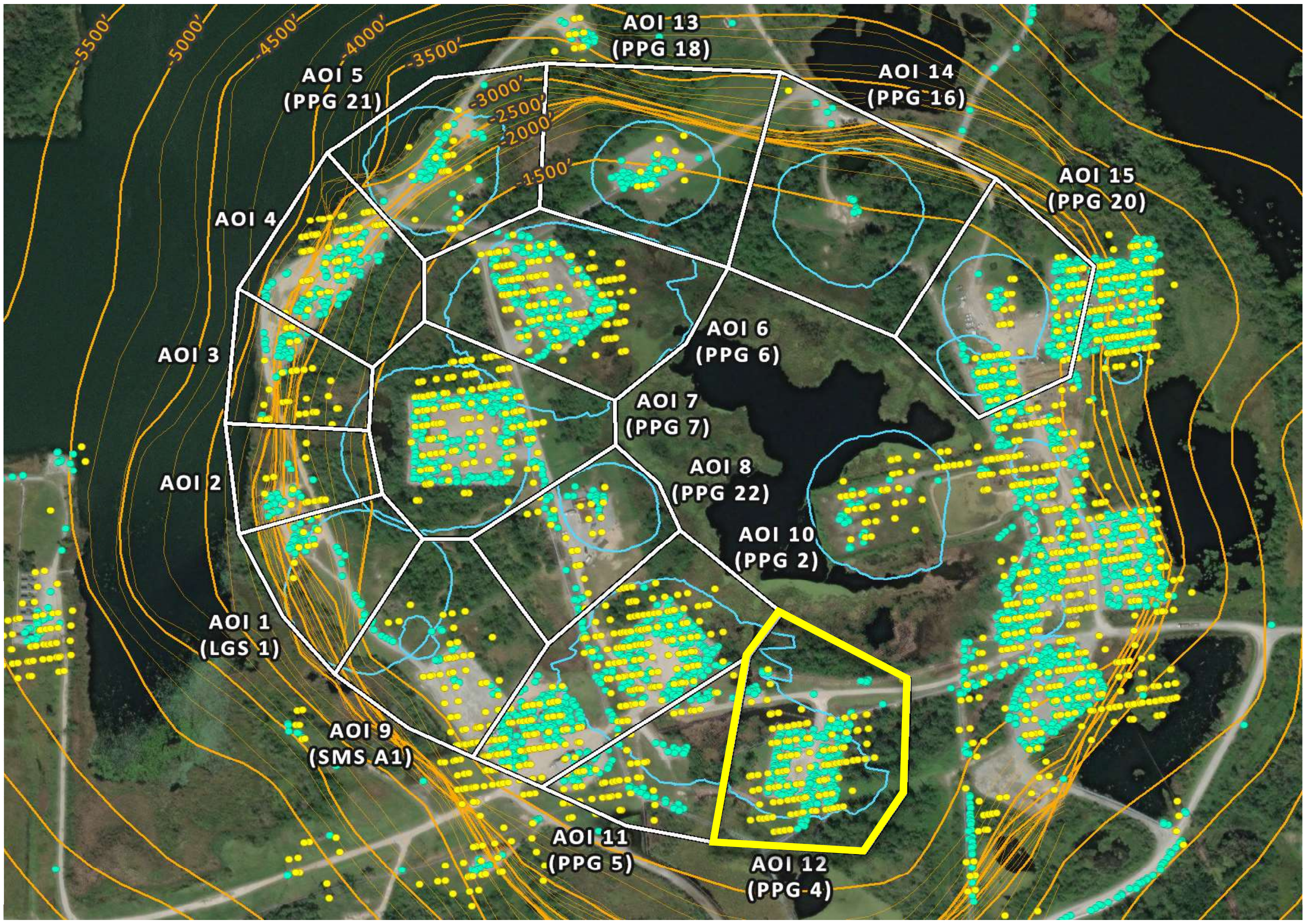
SNT (7/30/2024) Point Count: **53**



	Historical Trend Values	Recent Trend Values	Trend Change
Velocity:	-0.90 in/yr	-0.76 in/yr	+0.14 in/yr
Acceleration:	+0.06 in/yr^2	+0.14 in/yr^2	+0.08 in/yr^2

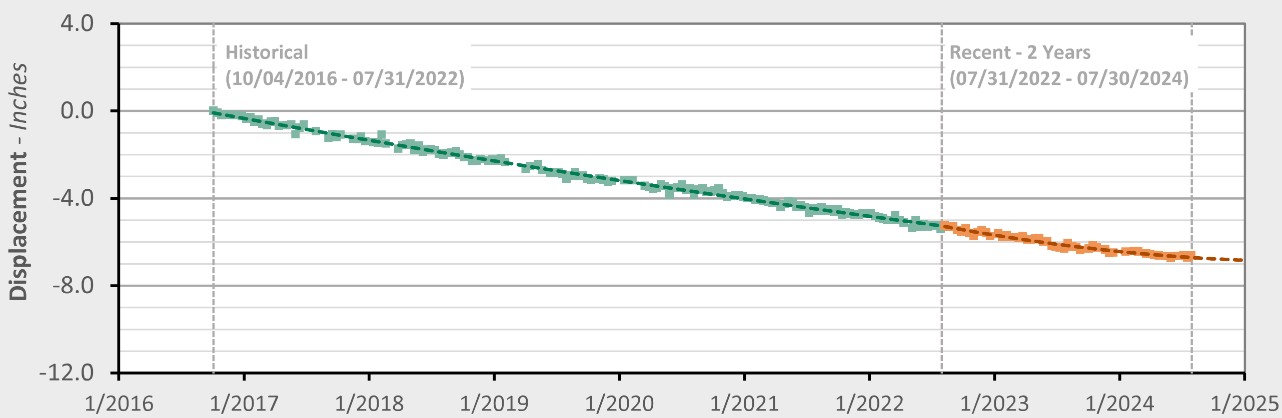
Historical LOS Displacement Measurement | Historical Trend Line (Quadratic Regression) | Recent LOS Displacement Measurement | Historical Trend Line (Quadratic Regression)

AOI 12 *(PPG 4)* - Location Map



AOI 12 *(PPG 4)* - Displacement Time Series

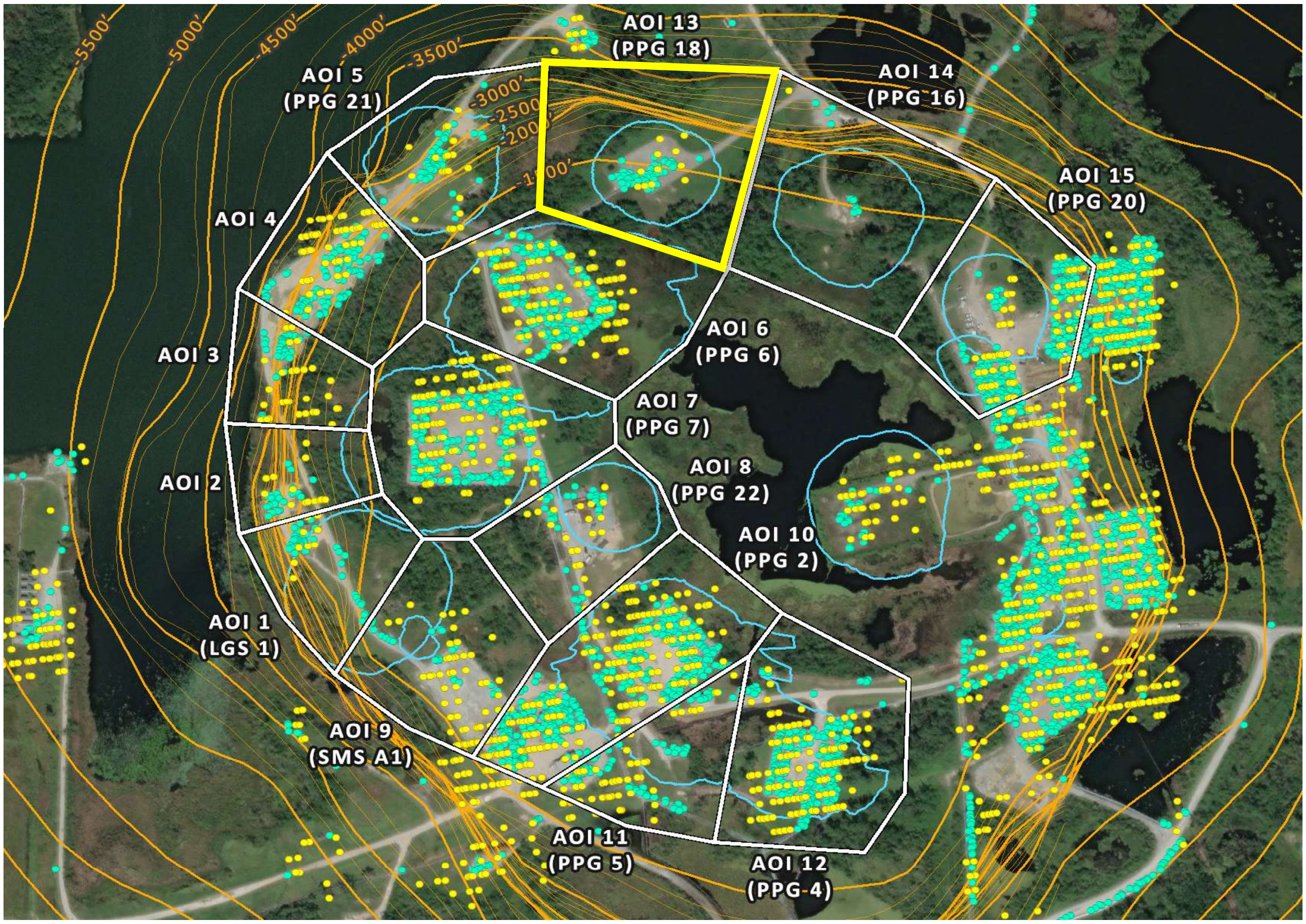
SNT (7/30/2024) Point Count: **120**



	Historical Trend Values	Recent Trend Values	Trend Change
Velocity:	-0.74 in/yr	-0.38 in/yr	+0.35 in/yr
Acceleration:	+0.05 in/yr^2	+0.34 in/yr^2	+0.29 in/yr^2

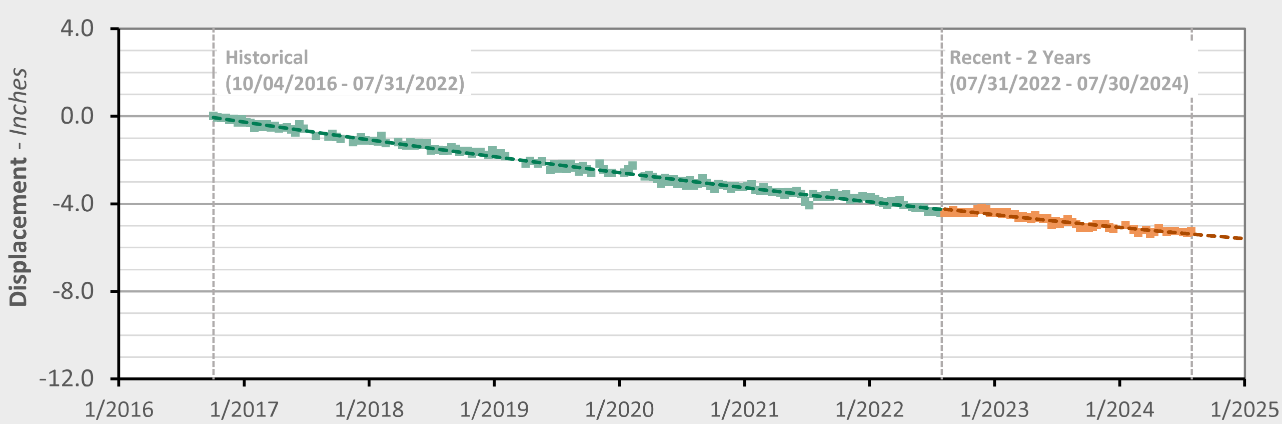
Historical LOS Displacement Measurement | Historical Trend Line (Quadratic Regression) | Recent LOS Displacement Measurement | Historical Trend Line (Quadratic Regression)

AOI 13 *(PPG 18)* - Location Map



AOI 13 *(PPG 18)* - Displacement Time Serie

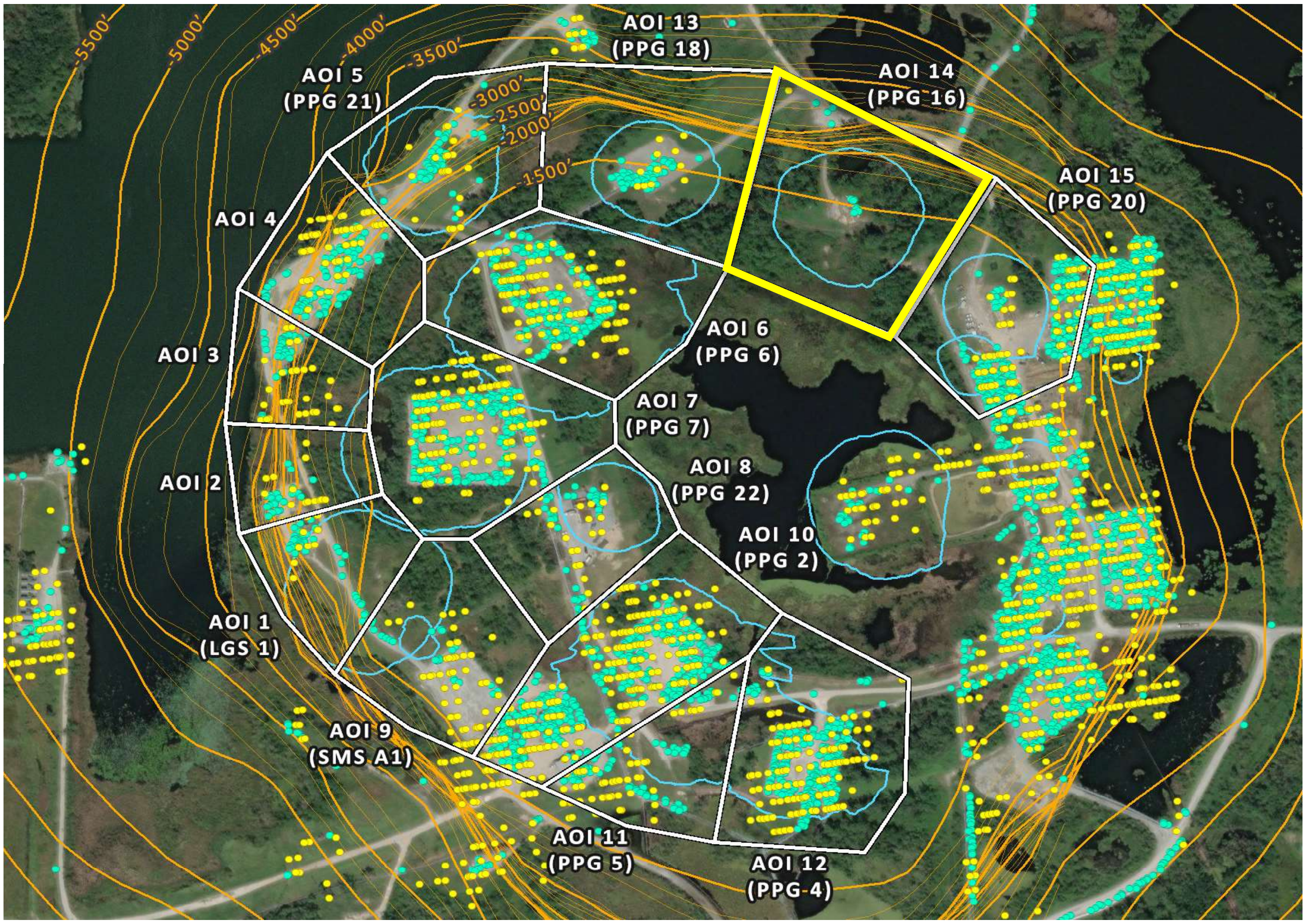
SNT (7/30/2024) Point Count: **12**



	Historical Trend Values	Recent Trend Values	Trend Change
Velocity:	-0.60 in/yr	-0.47 in/yr	+0.13 in/yr
Acceleration:	+0.04 in/yr^2	+0.12 in/yr^2	+0.08 in/yr^2

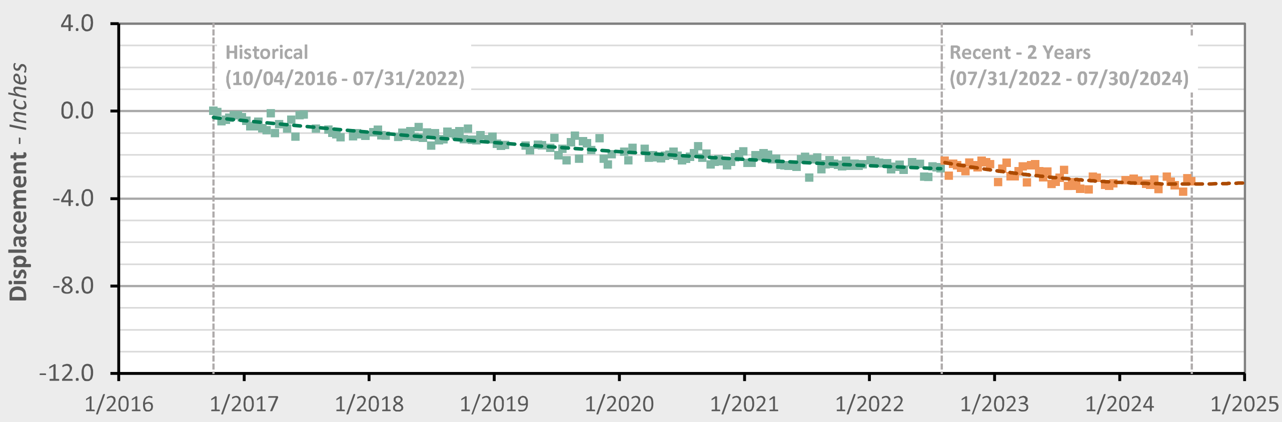
Historical LOS Displacement Measurement — Historical Trend Line (Quadratic Regression) — Recent LOS Displacement Measurement — Historical Trend Line (Quadratic Regression)

AOI 14 *(PPG 16)* - Location Map



AOI 14 *(PPG 16)* - Displacement Time Serie

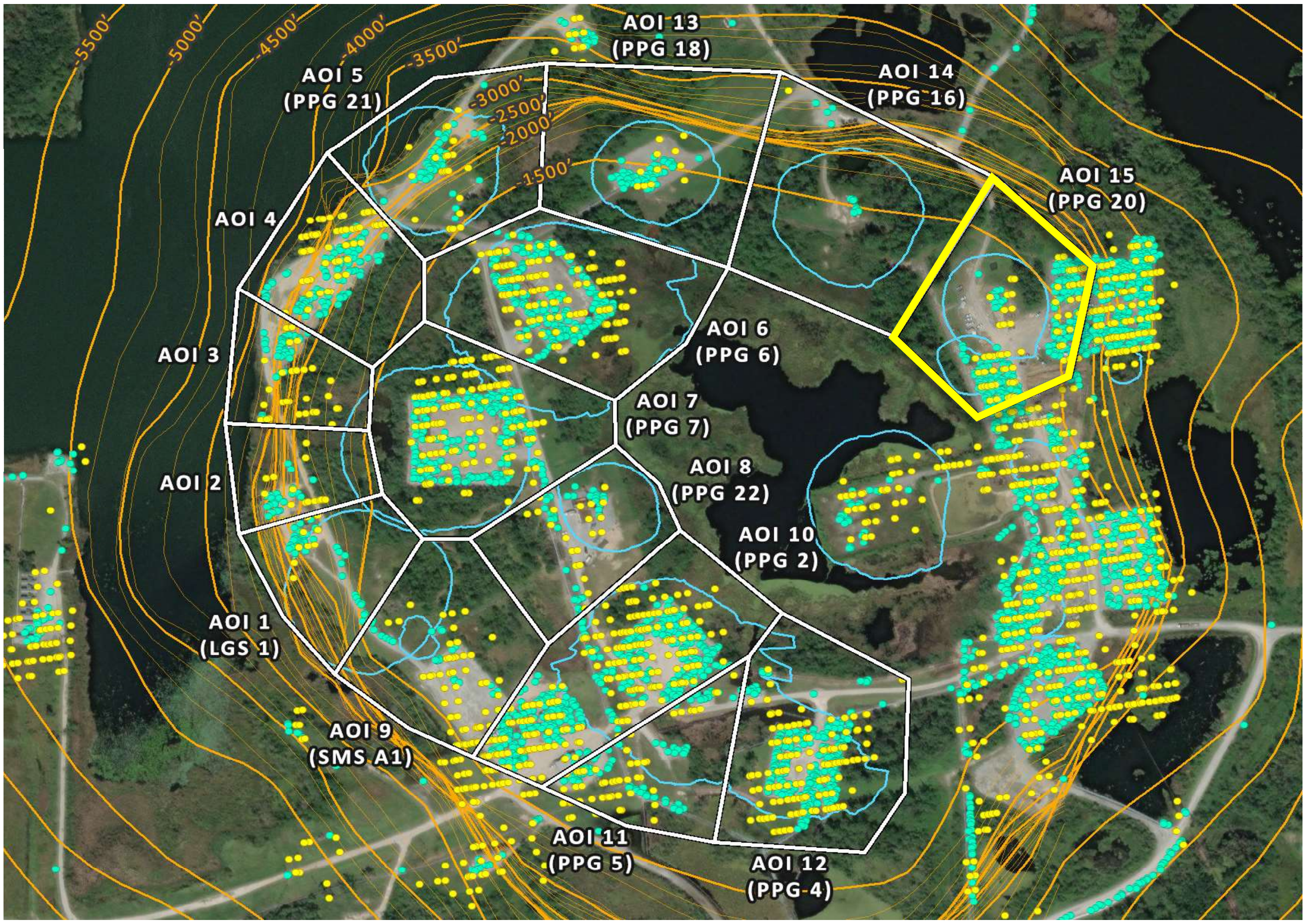
SNT (7/30/2024) Point Count: 1



	Historical Trend Values	Recent Trend Values	Trend Change
Velocity:	-0.23 in/yr	-0.00 in/yr	+0.22 in/yr
Acceleration:	+0.06 in/yr^2	+0.50 in/yr^2	+0.44 in/yr^2

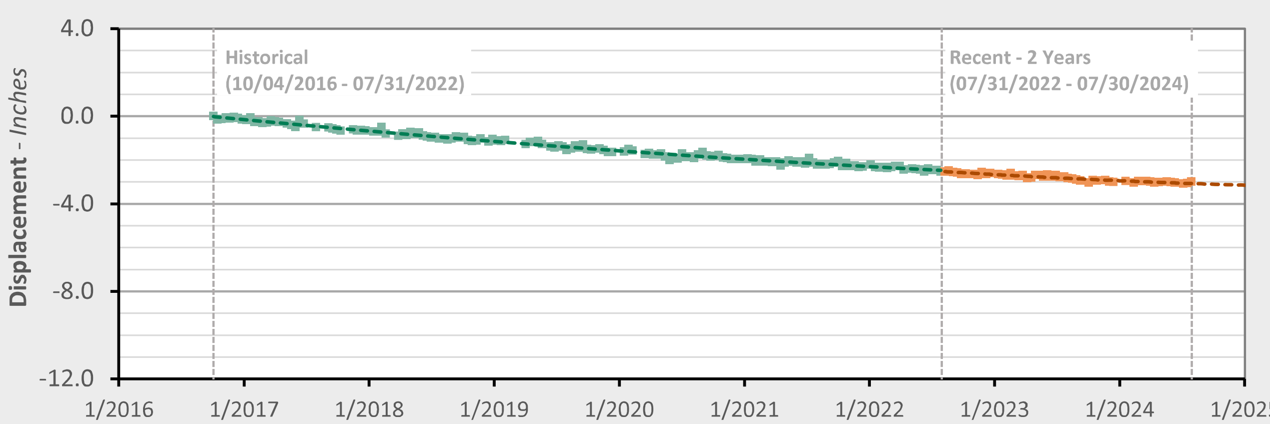
Historical LOS Displacement Measurement — Historical Trend Line (Quadratic Regression) — Recent LOS Displacement Measurement — Historical Trend Line (Quadratic Regression)

AOI 15 *(PPG 20)* - Location Map



AOI 15 *(PPG 20)* - Displacement Time Serie

SNT (7/30/2024) Point Count: **71**



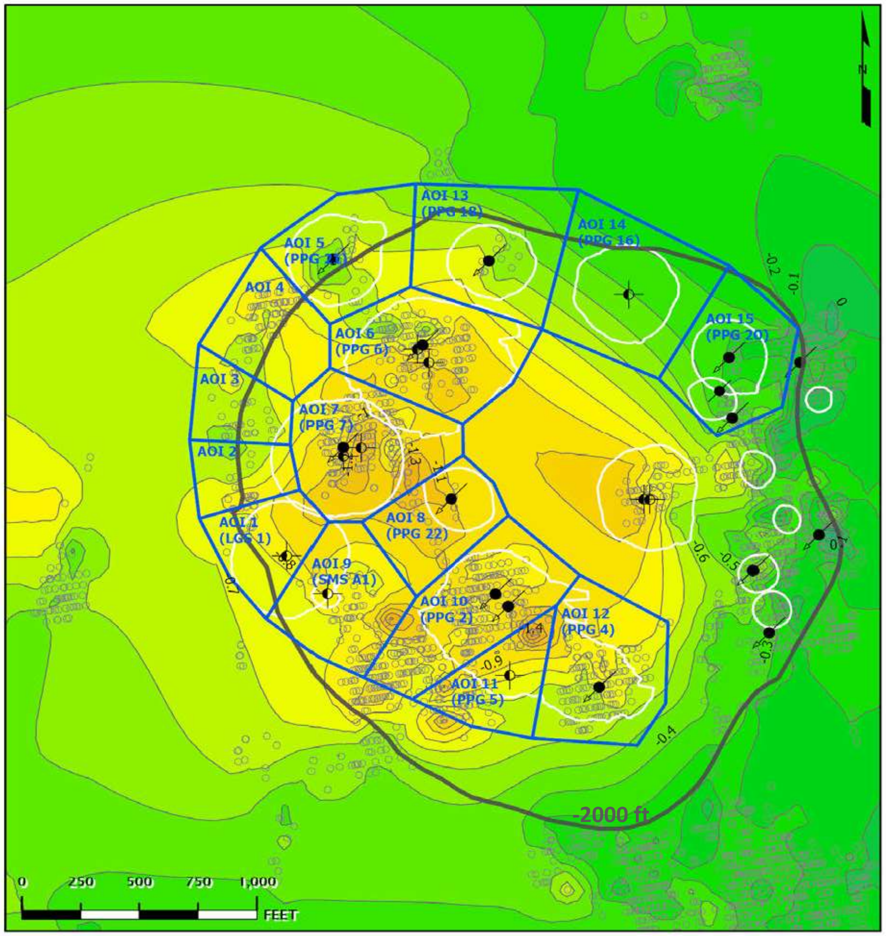
	Historical Trend Values	Recent Trend Values	Trend Change
Velocity:	-0.28 in/yr	-0.20 in/yr	+0.09 in/yr
Acceleration:	+0.05 in/yr^2	+0.08 in/yr^2	+0.03 in/yr^2

Historical LOS Displacement Measurement
Historical Trend Line (Quadratic Regression)
Recent LOS Displacement Measurement
Historical Trend Line (Quadratic Regression)

Historical SNT Data (10/04/2016 - 07/31/2022)

Velocity Contours

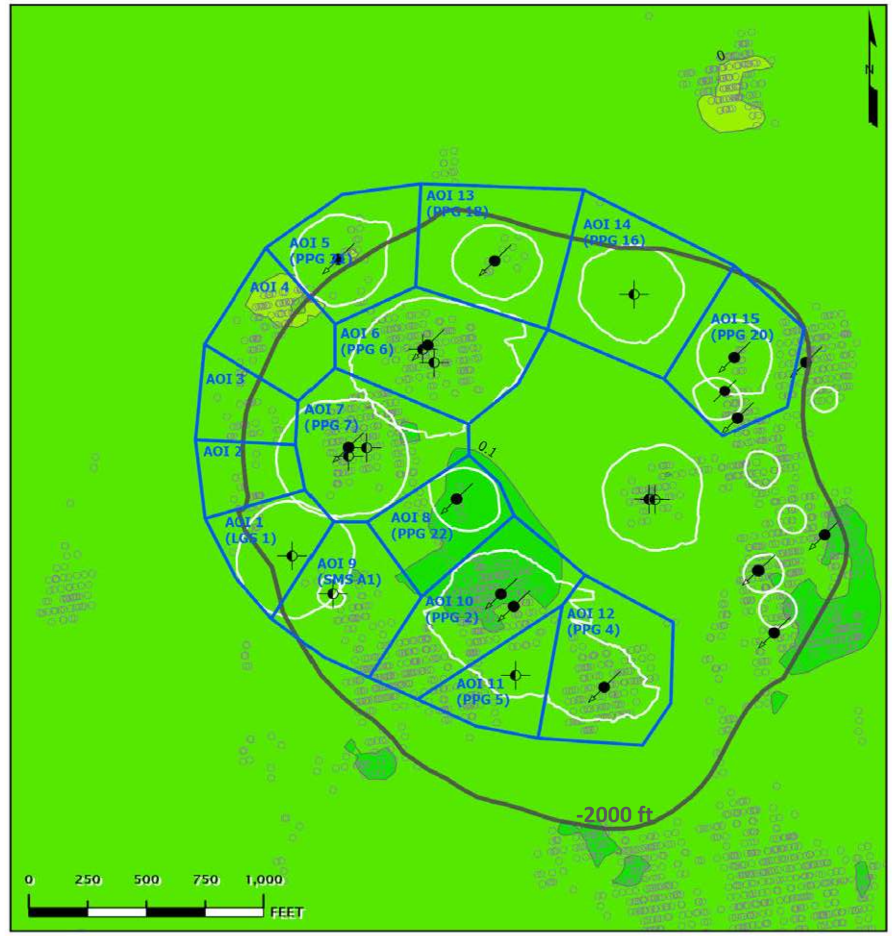
As of date: 07/31/2022



-2.0 -1.5 -1.0 -0.5 0.0 +0.5 +1.0 Inches/year

Acceleration Contours

Date range: 10/04/2016 - 07/31/2022



-1.0 -0.5 0.0 +0.5 +1.0 Inches/year^2

AOI Boundary | InSAR LOS Measurement Point | Contour (0.1)

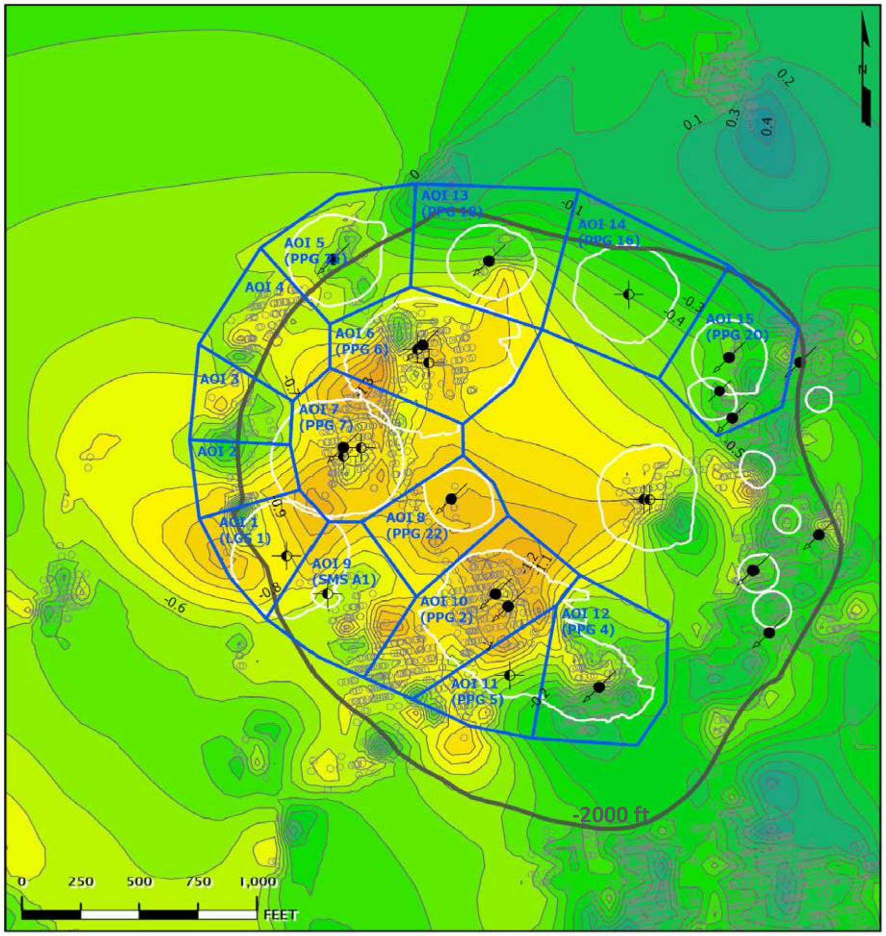
Historical Cavern Extent | Top of Dome (-2000 ft Contour)

Cavern Well Surface Locations: 09 - Active - Injection; 29 - Dry and Plugged

Recent SNT Data - 2 Years (07/31/2022 - 07/30/2024)

Velocity Contours

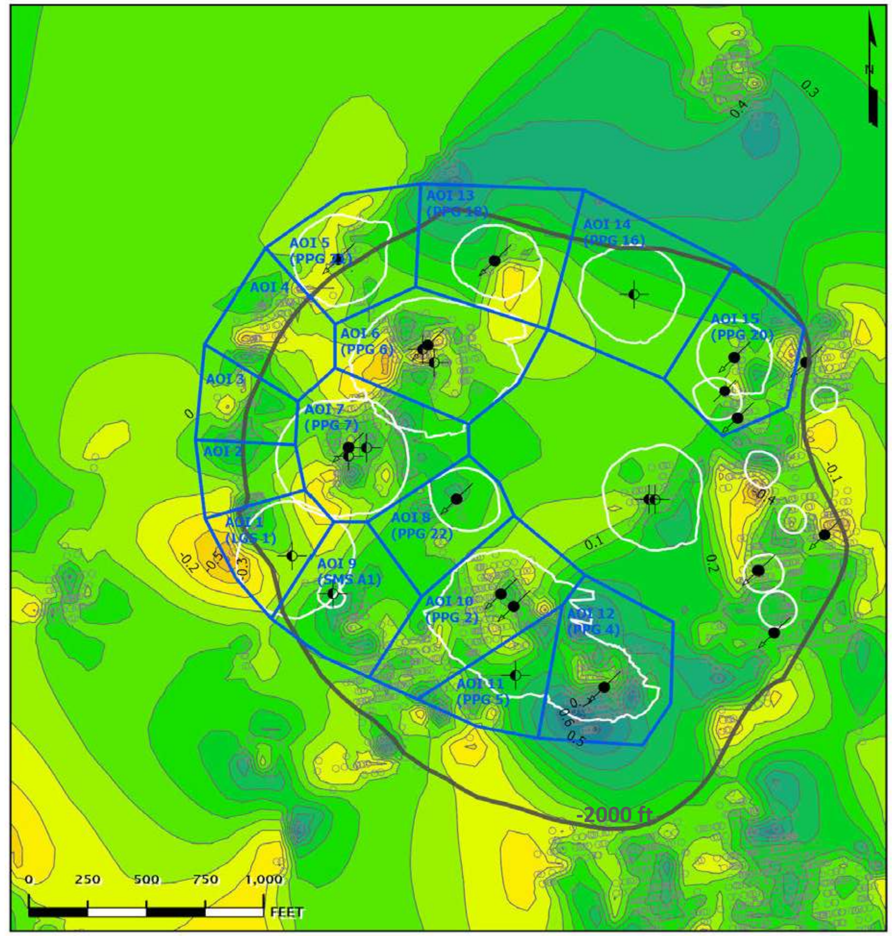
As of date: 07/30/2024



-2.0 -1.5 -1.0 -0.5 0.0 +0.5 +1.0 Inches/year

Acceleration Contours

Date range: 07/31/2022 - 07/30/2024



-1.0 -0.5 0.0 +0.5 +1.0 Inches/year^2

AOI Boundary ○ InSAR LOS Measurement Point — Contour (0.1)

Historical Cavern Extent Top of Dome (-2000 ft Contour)

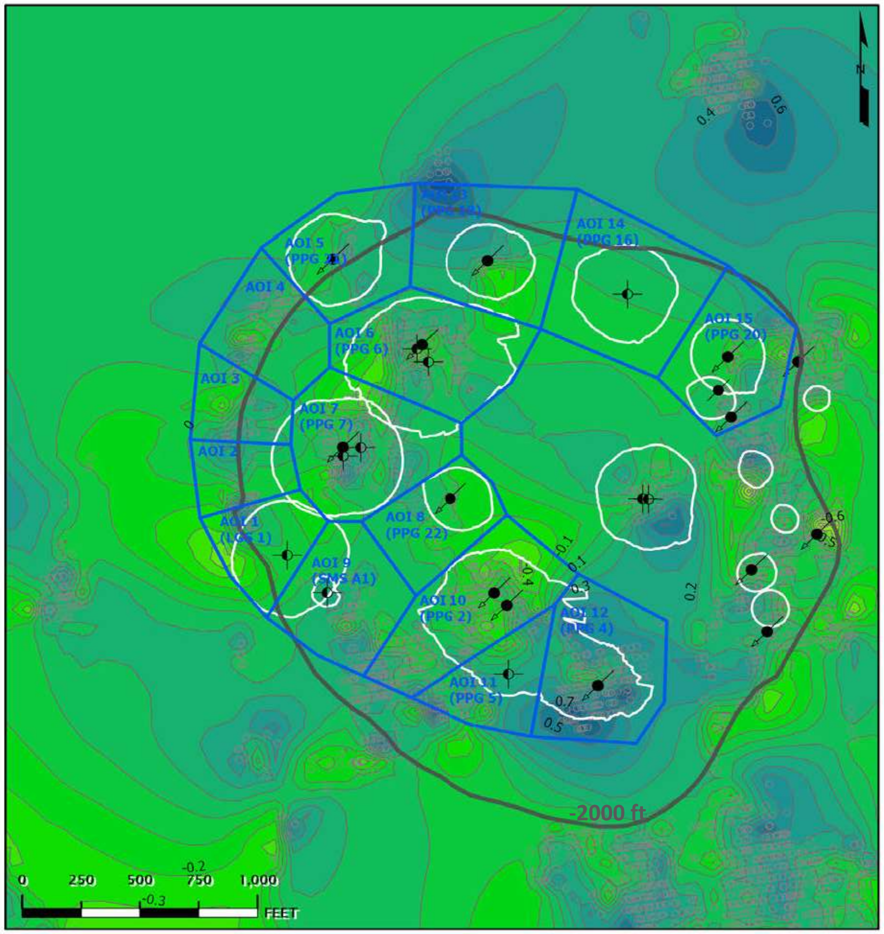
Cavern Well Surface Locations

09 - Active - Injection 29 - Dry and Plugged

Change from Historical to Recent SNT Data

Velocity Contours

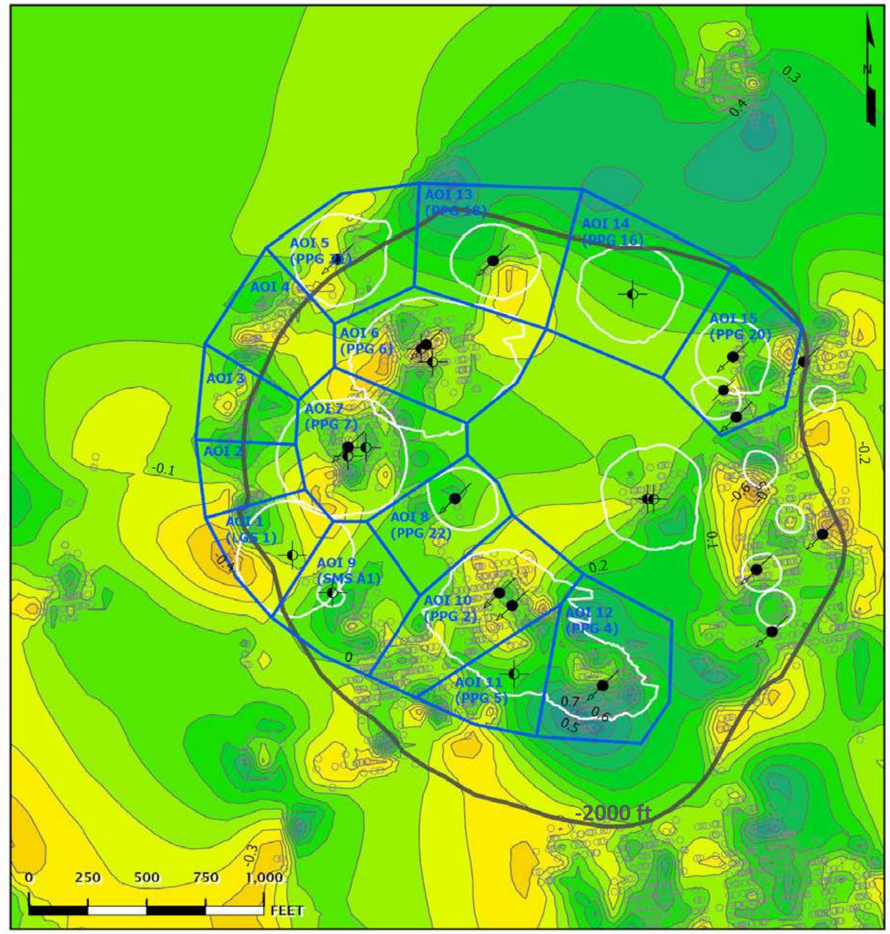
Historical Velocity subtracted from Recent Velocity



-2.0 -1.5 -1.0 -0.5 0.0 +0.5 +1.0 Inches/year

Acceleration Contours

Historical Acceleration subtracted from Recent Acceleration



-1.0 -0.5 0.0 +0.5 +1.0 Inches/year²

AOI Boundary | InSAR LOS Measurement Point | Contour (0.1) | Historical Cavern Extent | Top of Dome (-2000 ft Contour)

Cavern Well Surface Locations: 09 - Active - Injection; 29 - Dry and Plugged

ATTACHMENT C

TSX/PAZ InSAR report - July 27, 2024

TSX/PAZ Satellite Update

Continuous InSAR Monitoring of Ground Displacement At Westlake Caverns and Western Dome Flank

Sulphur Mines Salt Dome

Prepared for:
Westlake Chemical

Prepared by:
Lonquist & Co., LLC
8591 United Plaza Blvd.
Suite 280
Baton Rouge, LA 70809

Dataset
Satellite Source
TerraSAR-X - PAZ Constellation
Most Recent Image Date
Saturday, July 27, 2024

Analysis Report Date:

August 6, 2024

Dataset Information

Satellite Source	TerraSAR-X - PAZ Constellation
Revisit Frequency	4 and 7 days
Most Recent Image Date	Saturday, July 27, 2024
Dataset Image Count	98
Dataset Time Range	January 24, 2023 - July 27, 2024
Dataset Length	1.51 Years
Satellite Line-of-Sight (LOS)	37° East of Vertical (Viewing site from the East)

Analysis Methodology

Time Series Charts

Trend lines were calculated for the averaged displacement values within each AOI. Both a nonlinear (quadratic) and linear regression were applied to each AOI point group to identify rates of change in LOS displacement. These trends are displayed in the Time Series section of this report.

Contour Maps

A nonlinear (quadratic) and linear trend was also calculated for each individual measurement point across the analysis region. Nonlinear trend values for each point were used to generate Velocity and Acceleration contour maps to convey the spatial distribution of the calculated movement. The linear trend values for each point (which lack an acceleration component) were used to generate an additional Velocity contour map. Negative velocity values indicate subsidence or westward movement and positive velocity indicates uplift or eastward movement. Negative acceleration values indicate increasing rates of subsidence, increasing westward movement, or slowing eastward movement and positive acceleration values indicate slowing rates of subsidence, slowing westward movement, or increasing eastward movement.

Observations

To-date there have been no acute deviations from established subsidence trends in the areas investigated.

The timeframe of the dataset does not allow for comparison of recent to long-term LOS displacement rates. This dataset is primarily used to monitor for acute trend deviations and benefits from a higher measurement precision in individual readings than the SNT data.

Recent data has begun to indicate a negative acceleration of varying magnitudes across most of the AOI point groups evaluated. This is most evident in the trend acceleration values in the westernmost AOIs and in the mapped contours on the western side of AOI 2 and AOI 3. This suggests that marginal increases in subsidence rates may be occuring in this area of the dome. Seasonal effects are believed to contribute to fluctuations above and below the trend lines for each AOI and may play a siginficant role in the gradual changes that are being observed.

Date Signed: August 6, 2024
Austin, Texas

Nathaniel L. Byars, P.E.
Principal Engineer
Louisiana License No. 40697

InSAR Data Sources

InSAR Data

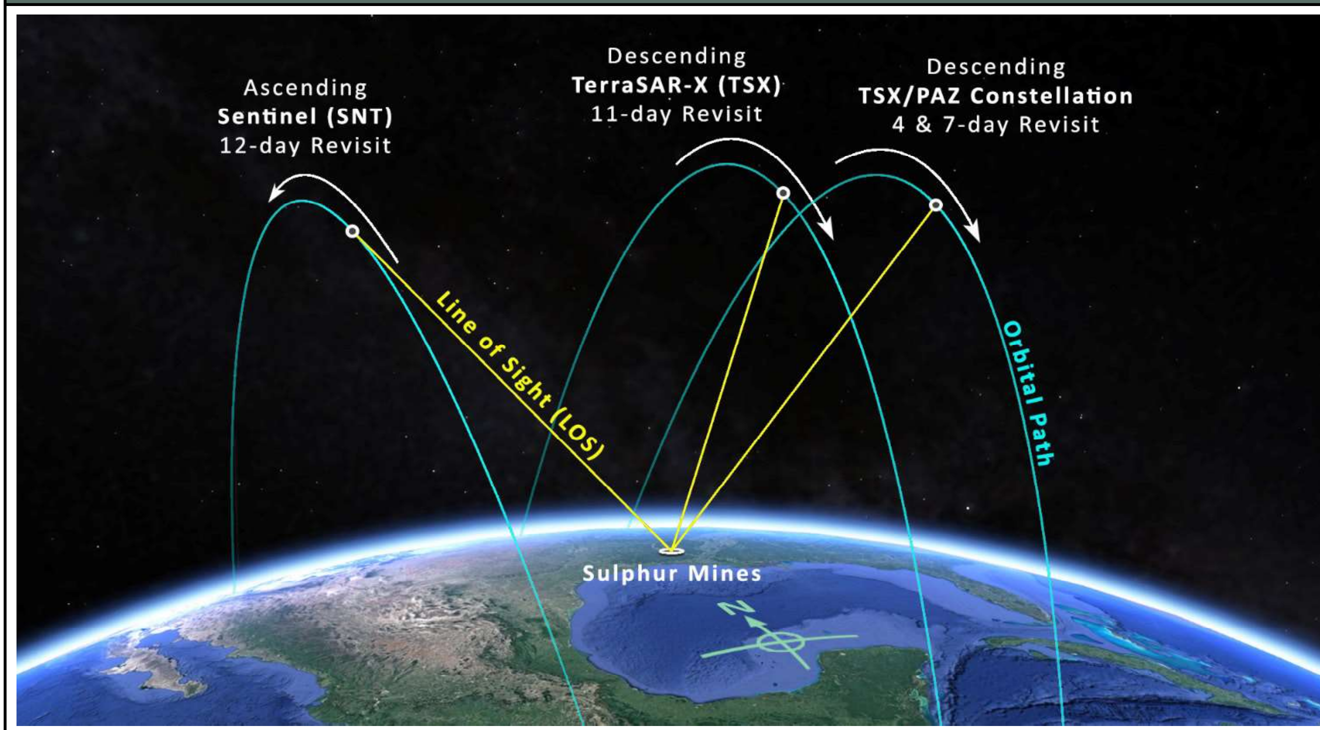
Interferometric Synthetic Aperture Radar (InSAR) is the most well established method to continually evaluate small, normally undetectable, ground movement over a large area. Radar imagery collected via satellites over successive orbital passes is used to identify and define measurement points on the ground. Objects or ground features providing a stable reflection of radar energy such as buildings, roads, and infrastructure produce the highest quality measurement points. InSAR analysis identifies the change in distance between the satellite and each measurement point over time relative to a stable reference point within the imaged area.

Satellite Sources

Two InSAR datasets are being used to evaluate subsidence over the Sulphur Mines Salt Dome. These datasets provide Line-of-Sight (LOS) displacment measurements from both ascending and descending orbits. An ascending orbit denotes the satellite's longitudinal course from south to north as it passes over the site, while a desceding orbit denotes the satellite is moving from north to south.

The first dataset comes from a low-resolution Sentinel-1 (SNT) satellite on an ascending orbit that captures data from the west of the site on a 12-day frequency. The second comes from a pair of high resolution satellites that share the same descending orbit and capture data from east of the site. These are a TSX satellite and the PAZ satellite (TSX/PAZ constellation), both with an 11-day revisit frequency. Their orbits are offset with the PAZ satellite passing over the site 4 days after the TSX satellite. Prior to May 2023, data was captured from a different high-resolution TerraSAR-X (TSX) satellite on a descending orbit that captured data from the east of the site on an 11-day frequency. The transition was made for the increased data frequency that resulted from a 4 and 7-day revisit period. The image below depicts the orbital paths of the satellites in relation to the Sulphur Mines Salt Dome.

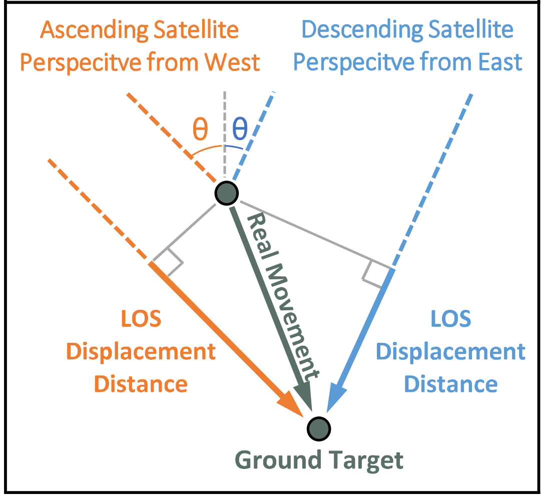
Satellite Orbital Diagram



InSAR Line-of-Site (LOS) Data

LOS displacement measurements refer to a change in distance between the satellite sensor and the ground target. Measurement positions on the west side of the Sulphur Dome are are known to be experiencing some eastward movement toward the dome center due to the geometry of the subsidence basin. The InSAR satellites view the site from eastward and westward positions so LOS measurements are understood to convey a movement distance that is not purely vertical. The diagram to the right illustrates the geometric relationship between the theoretical Real movement of a ground target and LOS displacement measurements from two different satellite viewing directions.

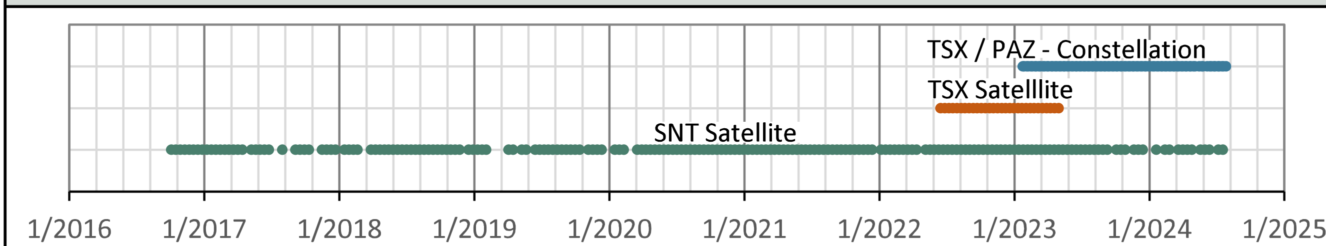
Side View



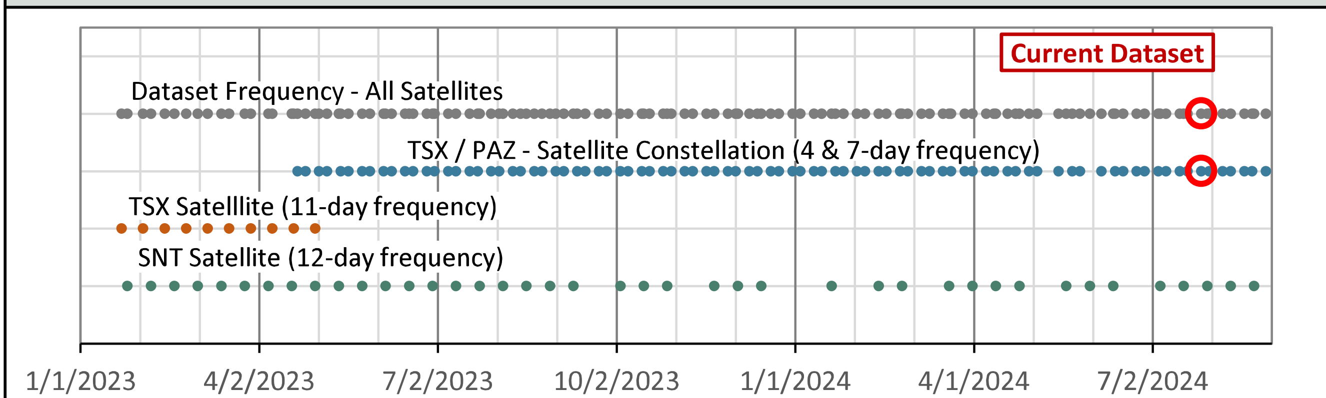
Satellite Properties & Image Frequency

Satellite and Data Properties	SNT	TSX	TSX/PAZ Constellation
Band (Wavelength)	C-band (2.20 in)	X-band (1.22 in)	X-band (1.22 in)
Track	T136	T29	T67 & T120
Pixel resolution	65 x 16 ft	3 x 3 ft	3 x 3 ft
Revisit frequency	12 days	11 days	4 & 7 days
Orbit (LOS Angle, θ)	Ascending (43°)	Descending (17°)	Descending (37°)
Data Start Date	10/4/2016	6/16/2022	1/24/2023
Measurement error range	± 0.20 in	± 0.03 in	± 0.03 in

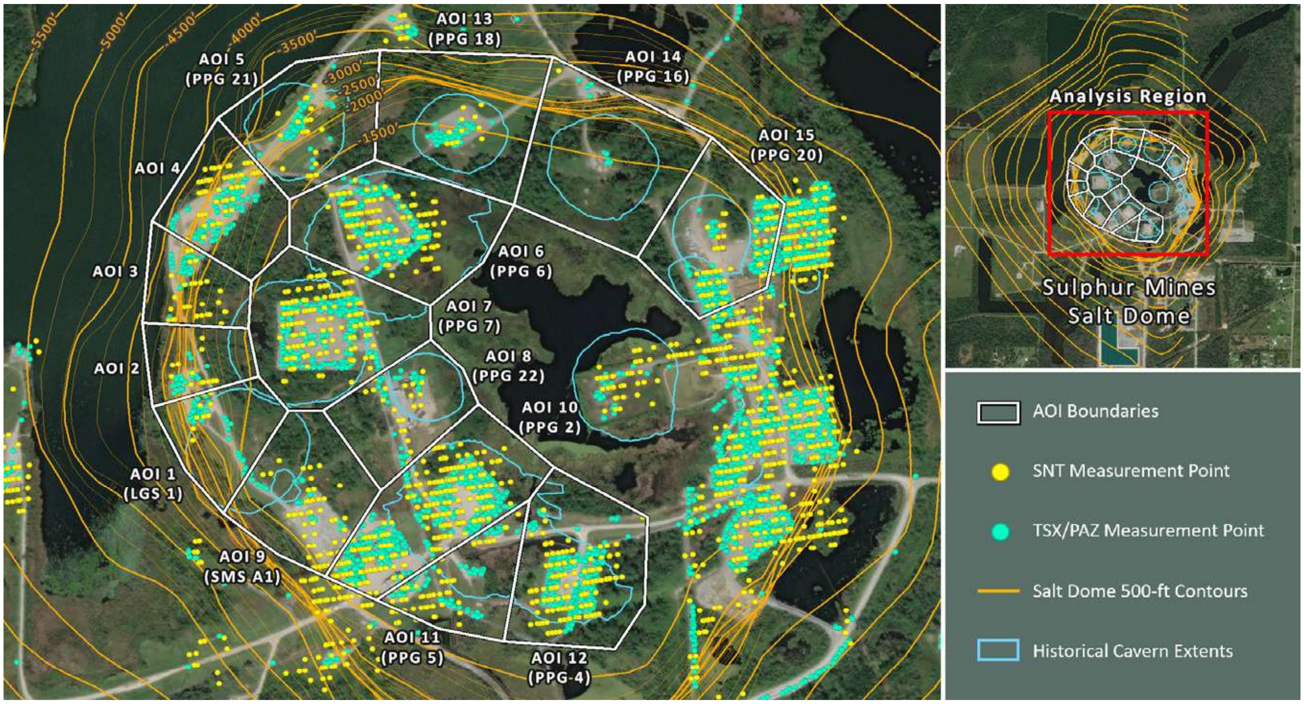
Dataset Measurement History



Dataset Update Frequency



AOI Boundaries & InSAR Measurement Points

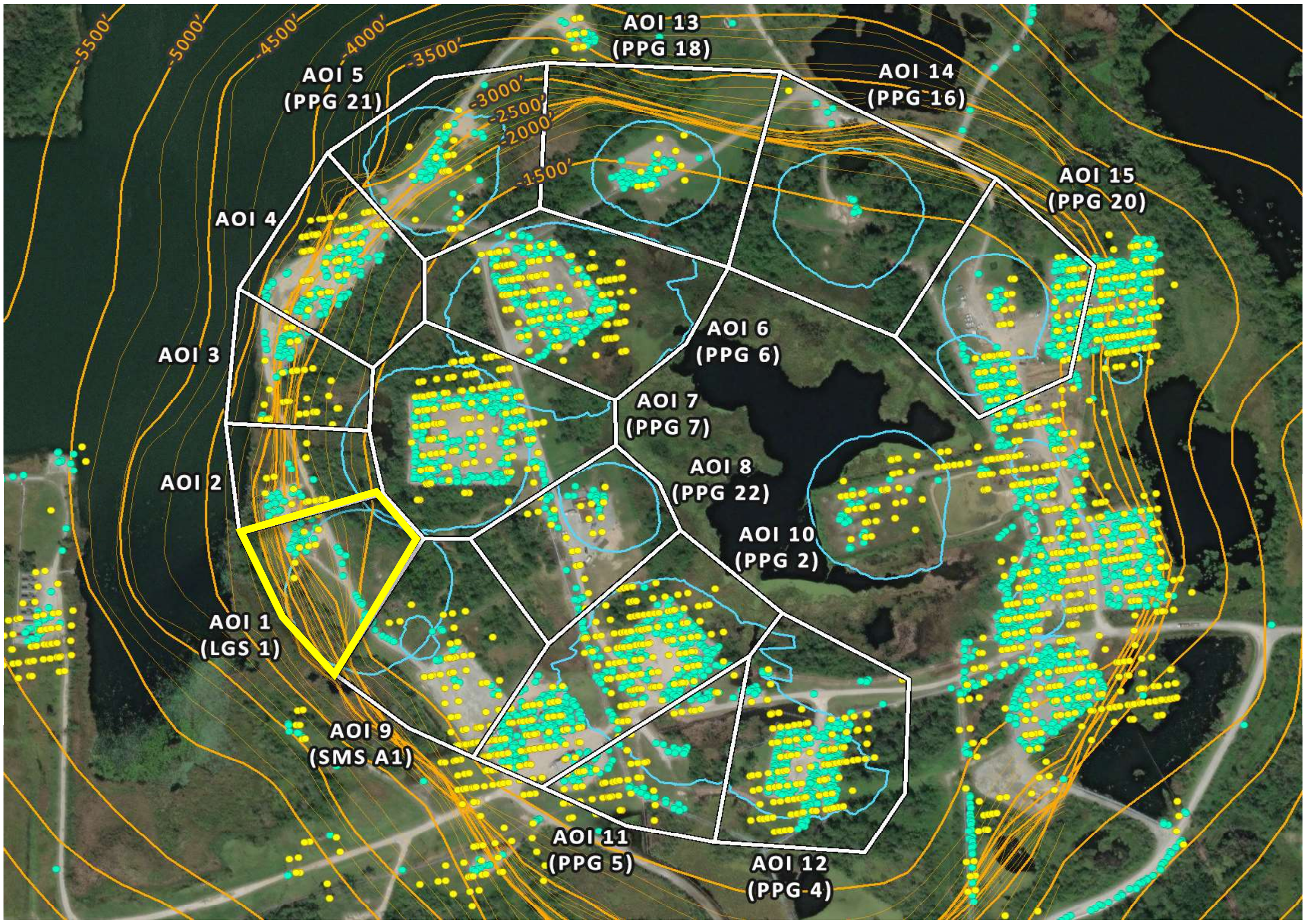


Subsidence Monitoring Areas of Interest (AOIs)

To visually convey and evaluate trend consistency for the displacement time series of each ground target, measurment points were grouped and their displacement values were averaged. The point groups are referred to as Areas of Interest (AOIs) in this analysis and their boundaries are depicted on the above map. The below table lists the trend values calculated in each AOI for the dataset evaluated in this report.

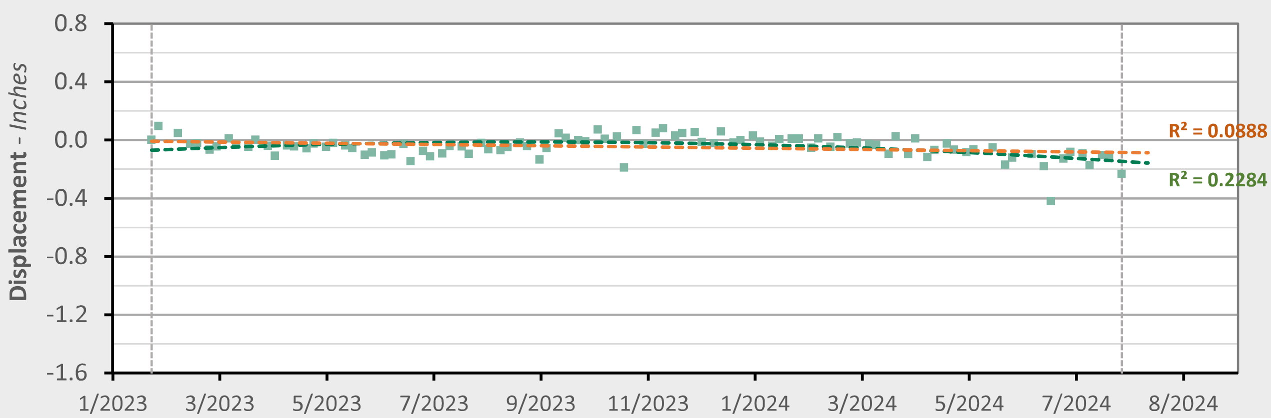
AOI Name	TSX/PAZ (7/27/2024)	LOS Velocity (in/yr)		LOS Acceleration (in/yr²)	
	Point Count	Nonlinear	Linear	Nonlinear	Linear
AOI 1 *(LGS 1)*	42	-0.29	-0.05	-0.32	0.00
AOI 2	24	-0.37	-0.04	-0.43	0.00
AOI 3	40	-0.42	-0.03	-0.52	0.00
AOI 4	102	-0.24	+0.02	-0.35	0.00
AOI 5 *(PPG 21)*	47	-0.27	-0.17	-0.12	0.00
AOI 6 *(PPG 6)*	212	-0.58	-0.41	-0.23	0.00
AOI 7 *(PPG 7)*	216	-0.53	-0.29	-0.32	0.00
AOI 8 *(PPG 22)*	36	-0.64	-0.57	-0.10	0.00
AOI 9 *(SMS A1)*	23	-0.09	-0.23	+0.18	0.00
AOI 10 *(PPG 2)*	404	-0.69	-0.55	-0.19	0.00
AOI 11 *(PPG 5)*	85	-0.53	-0.45	-0.11	0.00
AOI 12 *(PPG 4)*	262	-0.90	-0.81	-0.12	0.00
AOI 13 *(PPG 18)*	52	-0.57	-0.43	-0.19	0.00
AOI 14 *(PPG 16)*	11	-0.35	-0.63	+0.37	0.00
AOI 15 *(PPG 20)*	224	-0.94	-0.94	+0.00	0.00

AOI 1 *(LGS 1)* - Location Map



AOI 1 *(LGS 1)* - Displacement Time Series

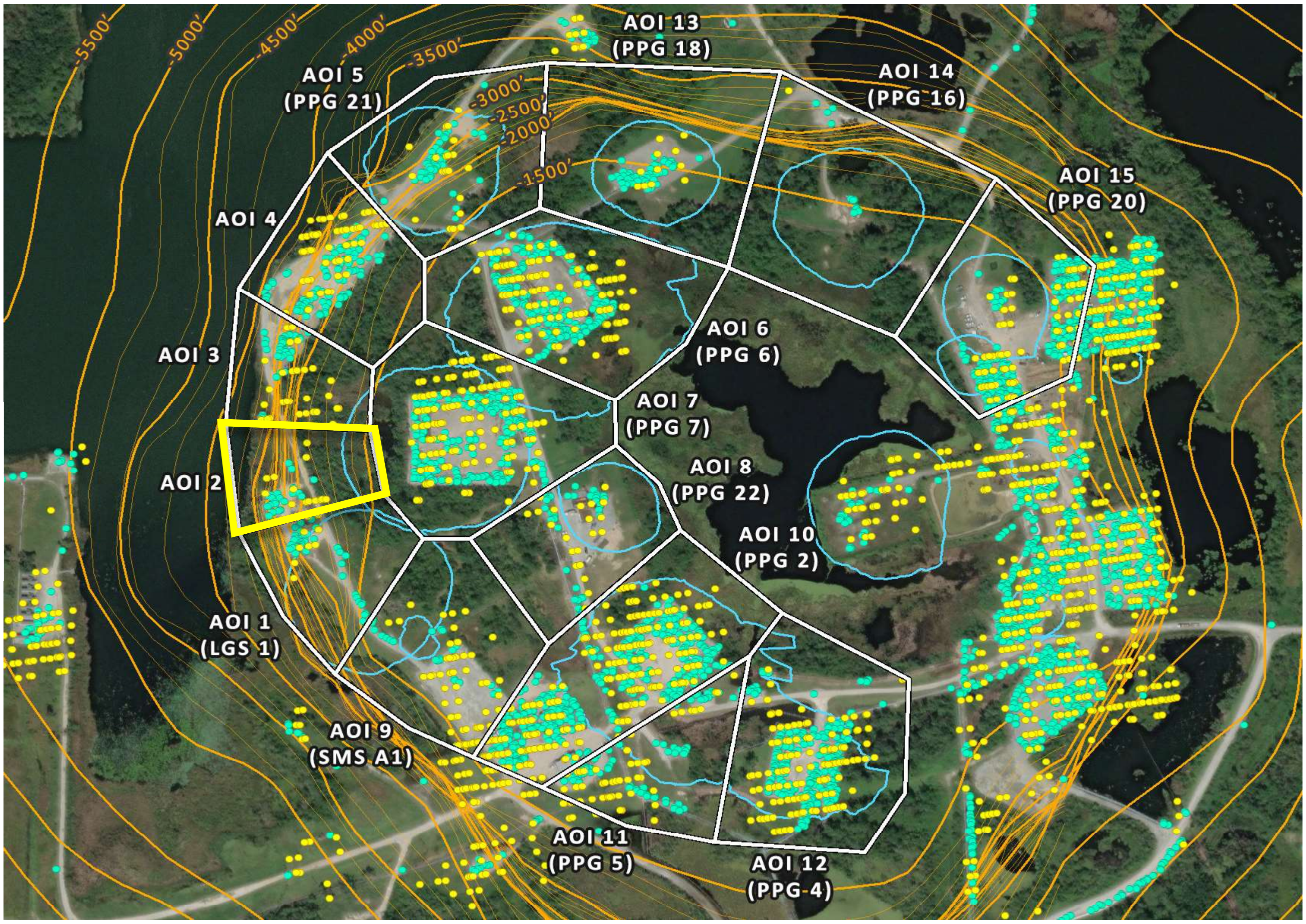
TSX/PAZ (7/27/2024) Point Count: **42**



	Nonlinear Trend	Linear Trend
Velocity:	-0.29 in/yr	-0.05 in/yr
Acceleration:	-0.32 in/yr^2	0.00 in/yr^2

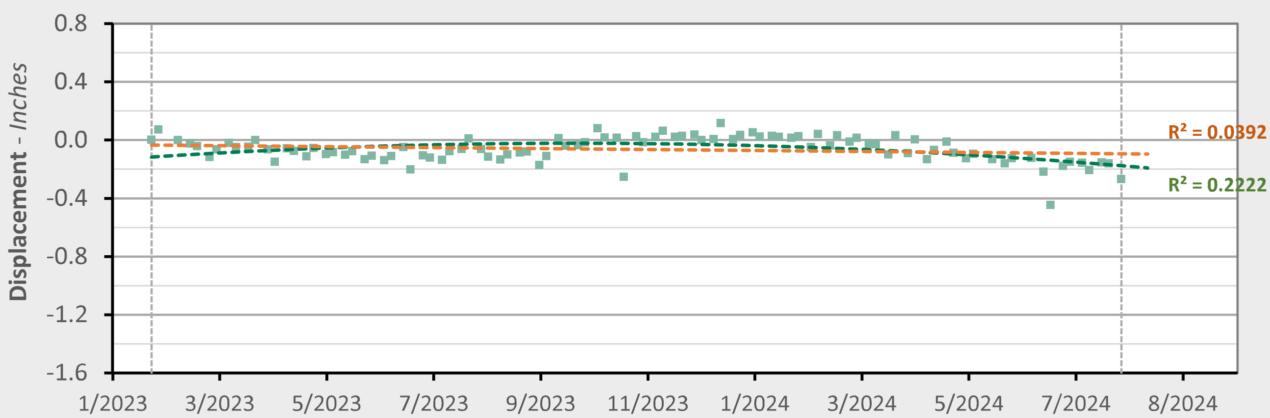
LOS Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 2 - Location Map



AOI 2 - Displacement Time Series

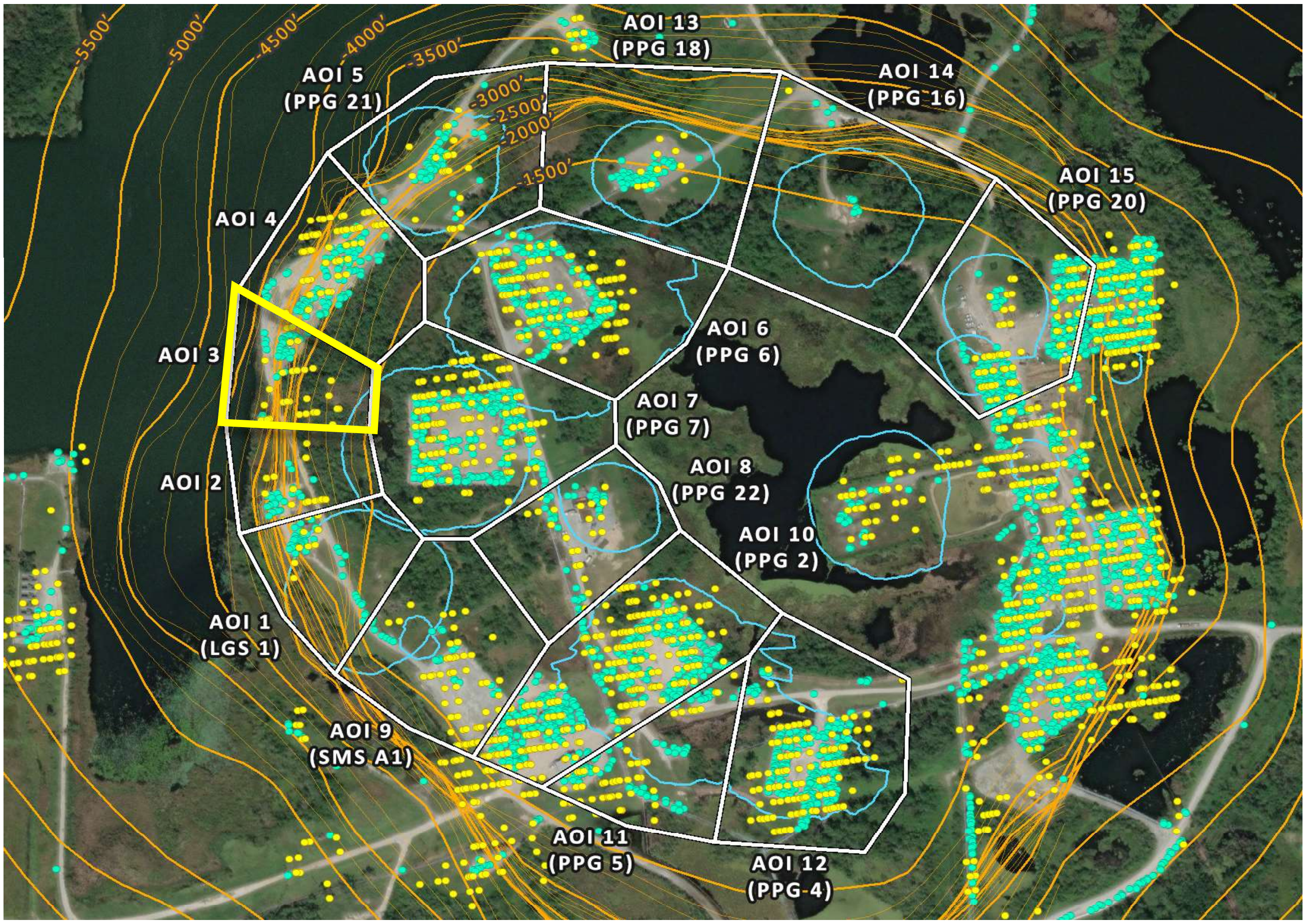
TSX/PAZ (7/27/2024) Point Count: 24



	Nonlinear Trend	Linear Trend
Velocity:	-0.37 in/yr	-0.04 in/yr
Acceleration:	-0.43 in/yr^2	0.00 in/yr^2

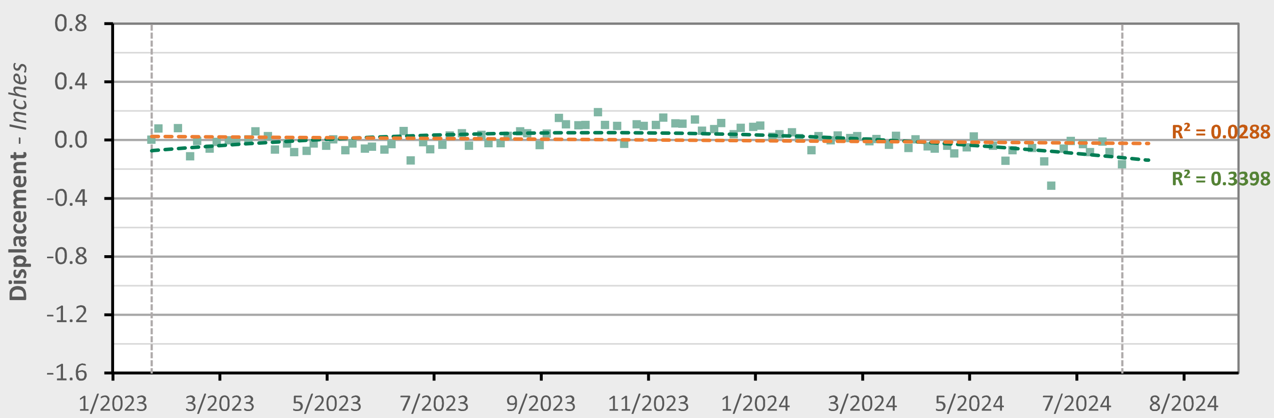
LOS Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 3 - Location Map



AOI 3 - Displacement Time Series

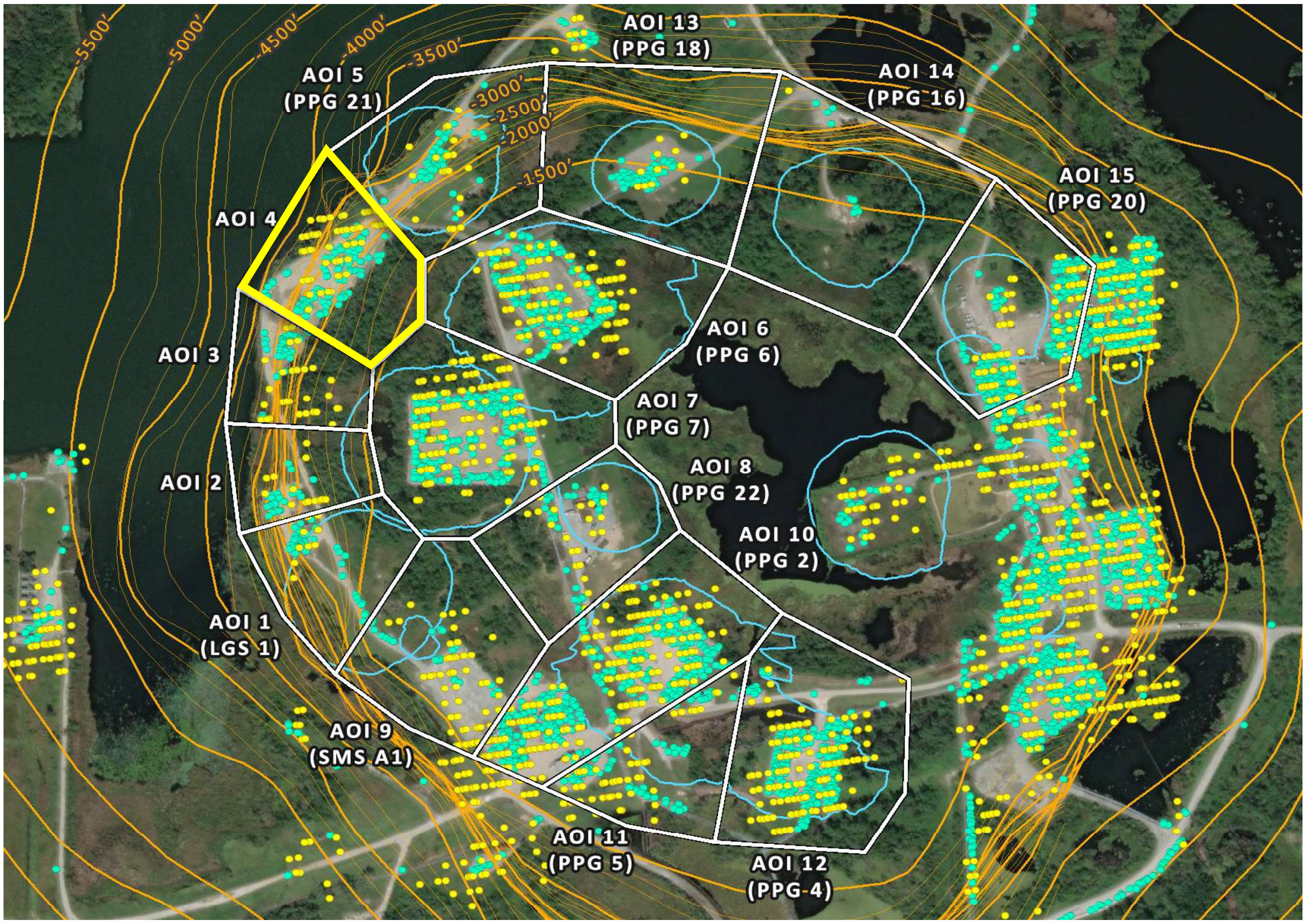
TSX/PAZ (7/27/2024) Point Count: **40**



	Nonlinear Trend	Linear Trend
Velocity:	-0.42 in/yr	-0.03 in/yr
Acceleration:	-0.52 in/yr^2	0.00 in/yr^2

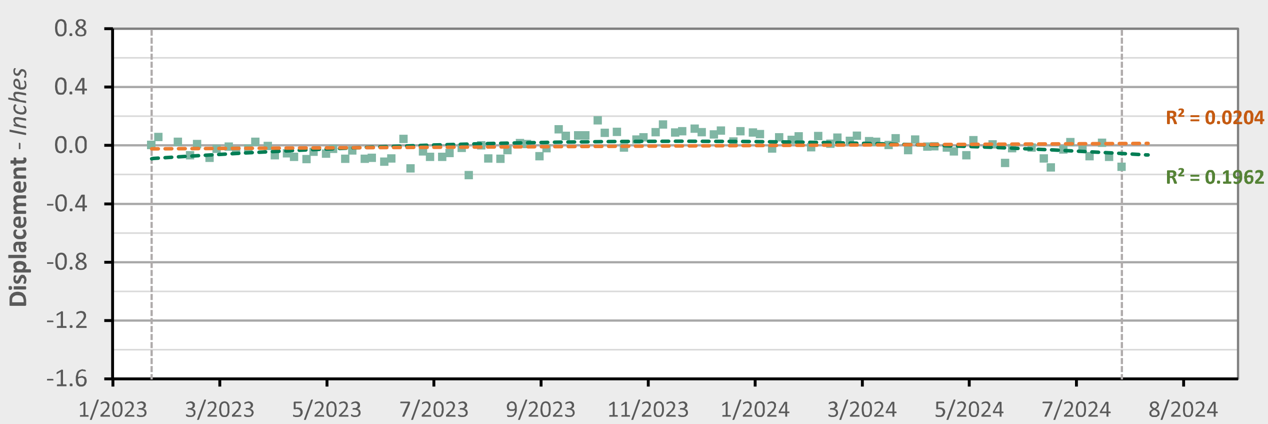
LOS Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 4 - Location Map



AOI 4 - Displacement Time Series

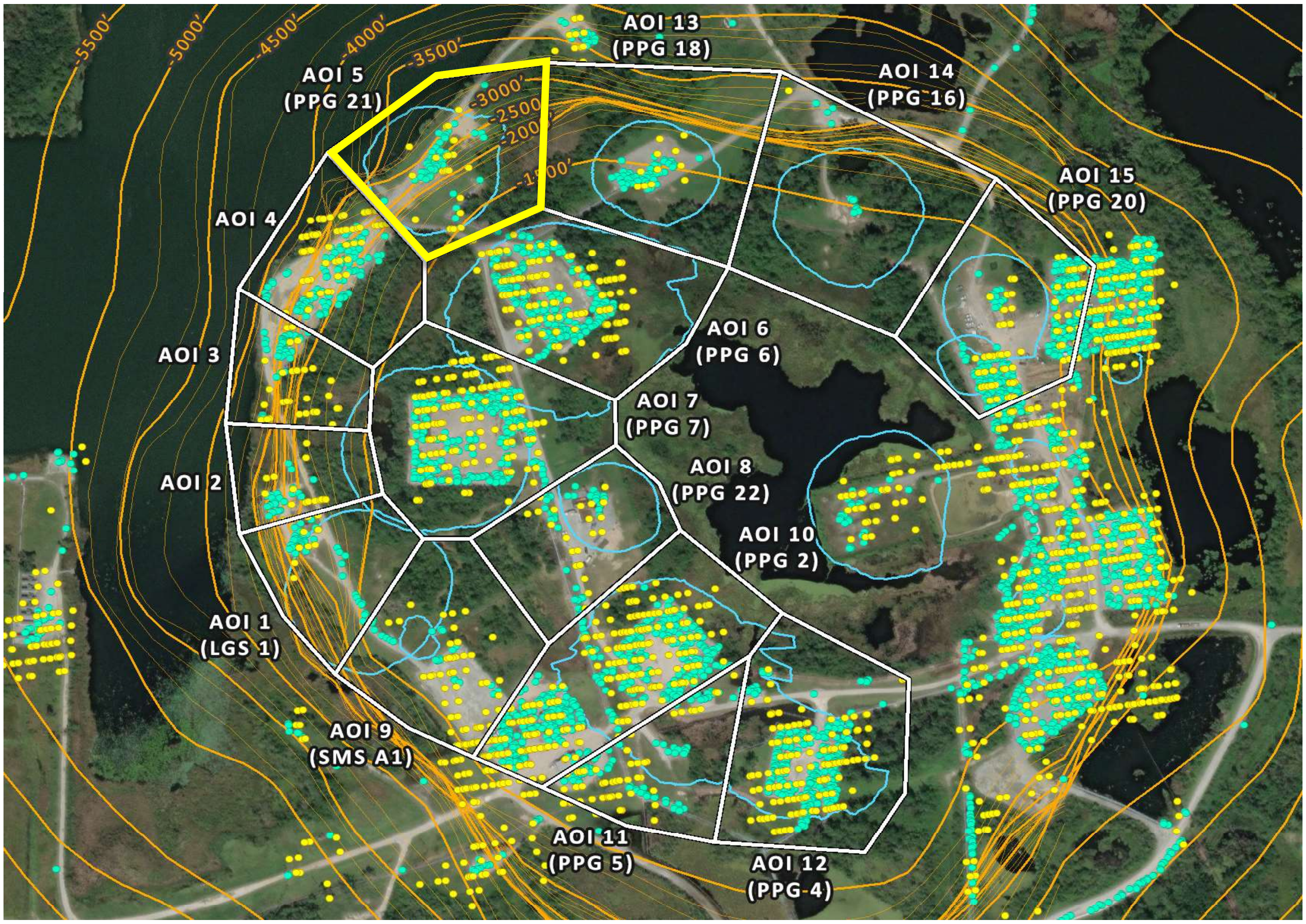
TSX/PAZ (7/27/2024) Point Count: **102**



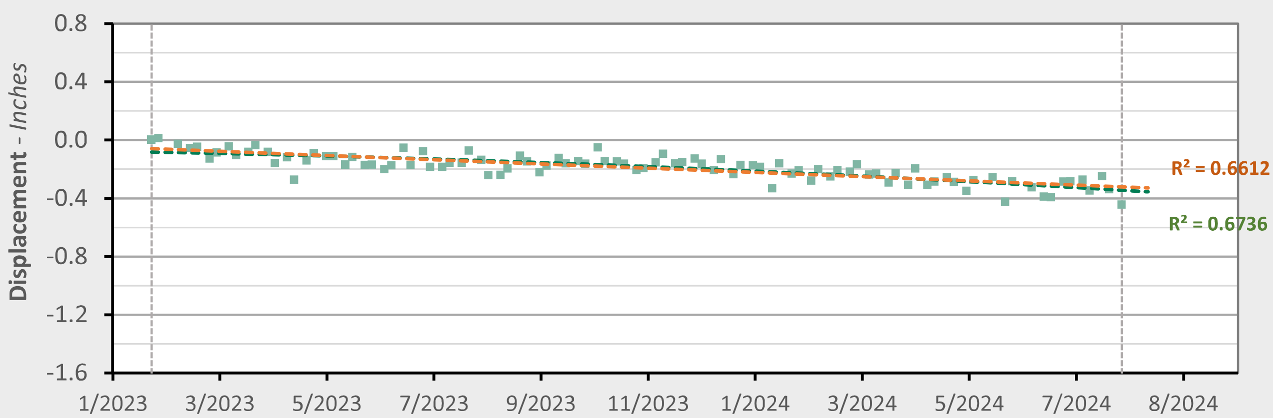
	Nonlinear Trend		Linear Trend	
Velocity:	-0.24	in/yr	+0.02	in/yr
Acceleration:	-0.35	in/yr^2	0.00	in/yr^2

LOS Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 5 *(PPG 21)* - Location Map



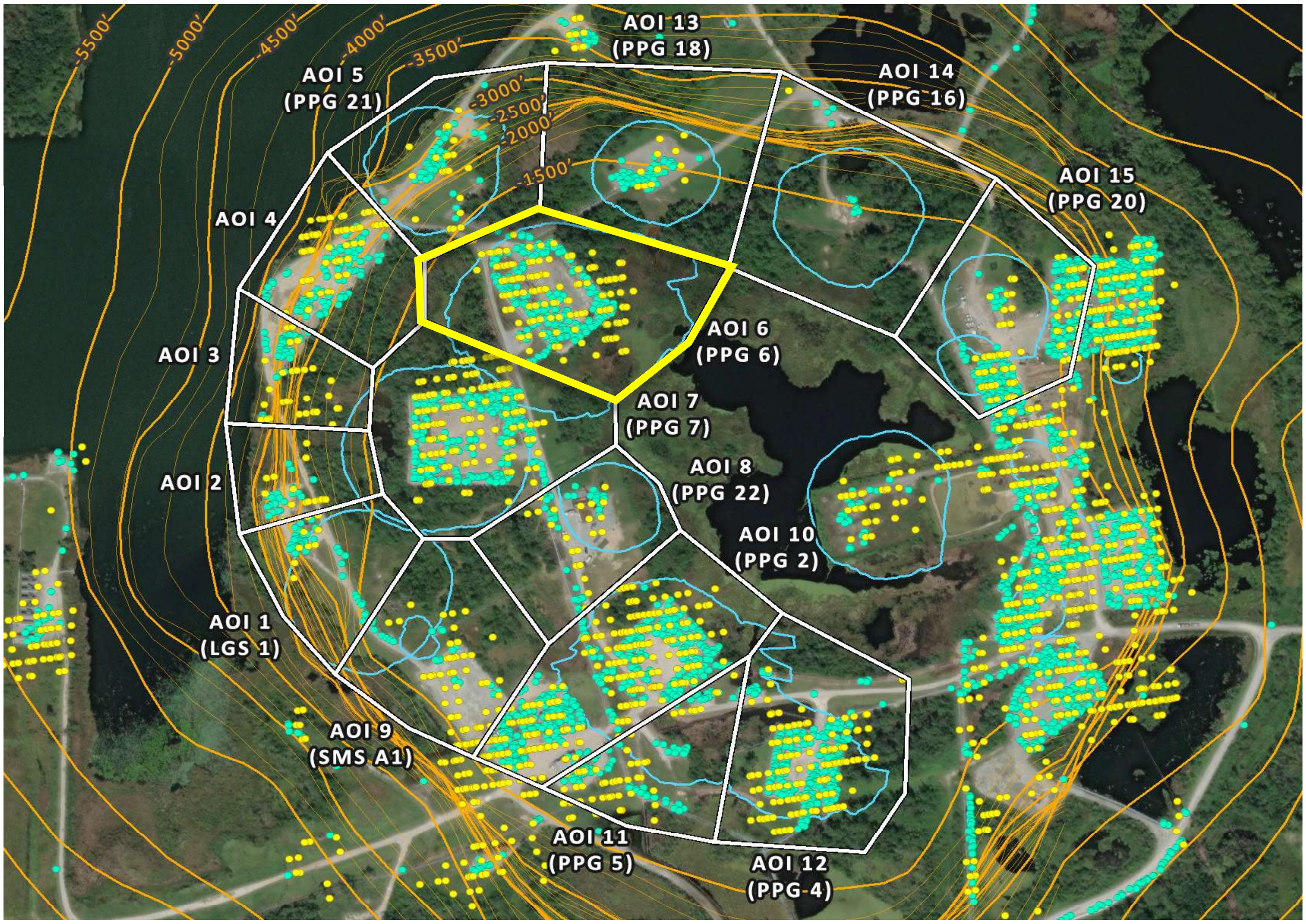
AOI 5 *(PPG 21)* - Displacement Time Series TSX/PAZ (7/27/2024) Point Count: 47



	Nonlinear Trend	Linear Trend
Velocity:	-0.27 in/yr	-0.17 in/yr
Acceleration:	-0.12 in/yr^2	0.00 in/yr^2

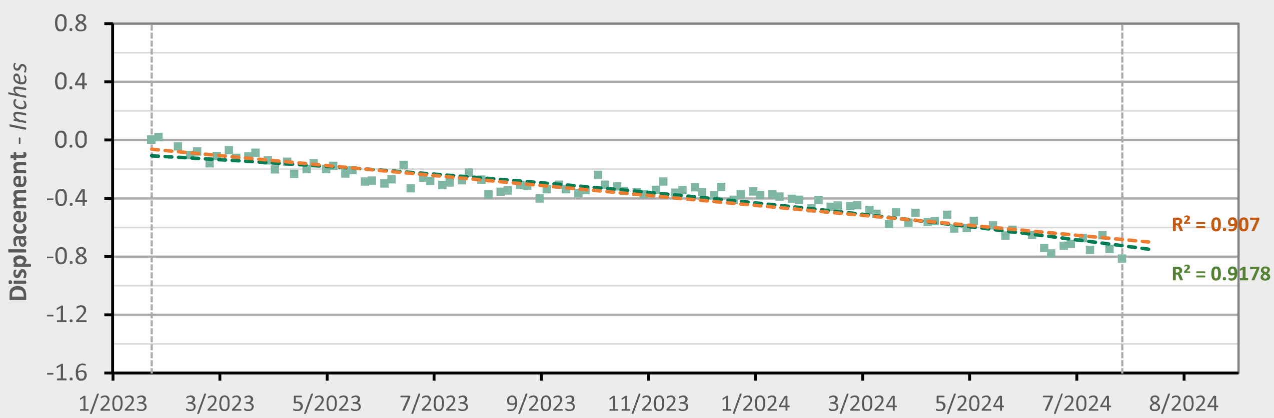
LOS Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 6 *(PPG 6)* - Location Map



AOI 6 *(PPG 6)* - Displacement Time Series

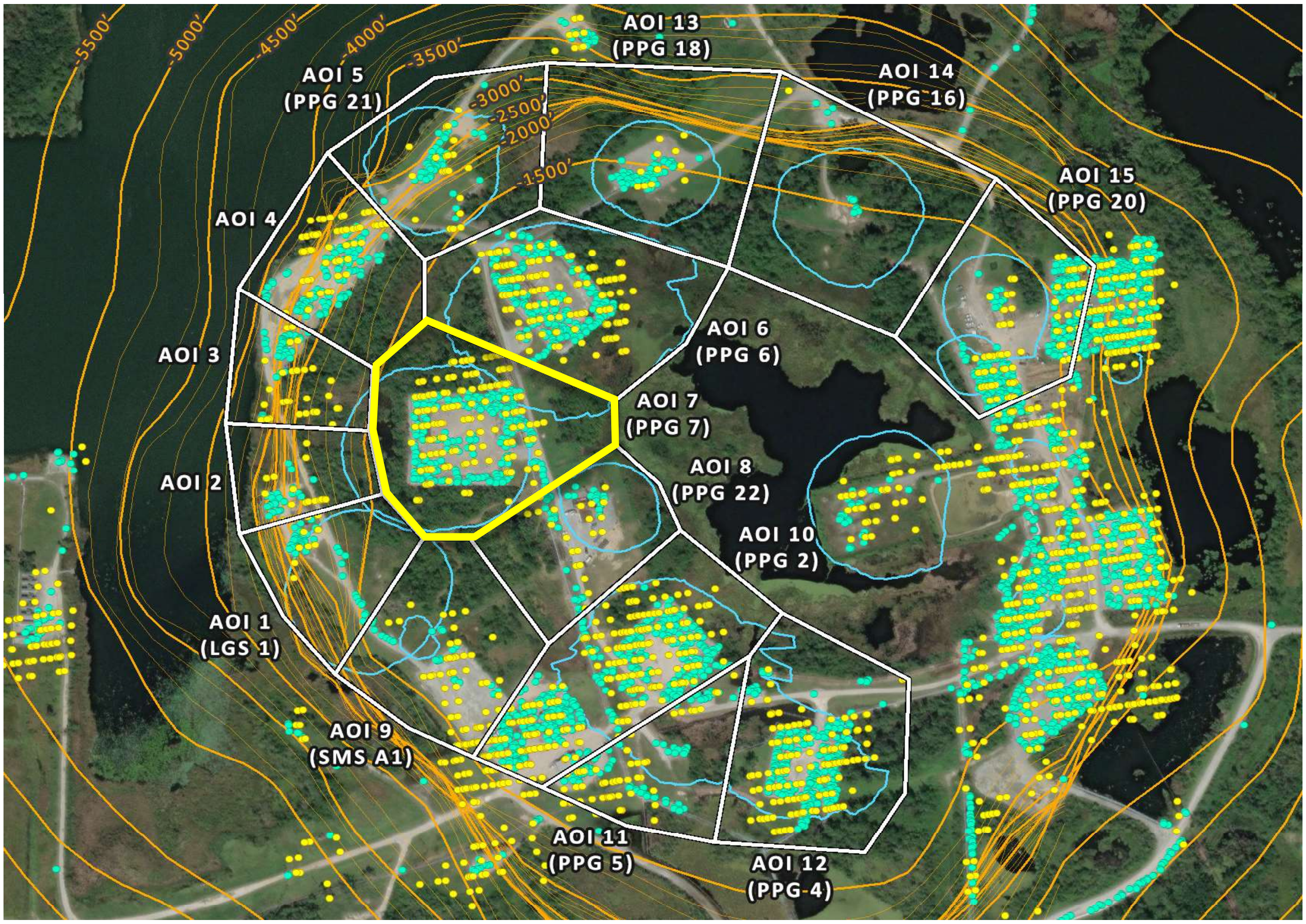
TSX/PAZ (7/27/2024) Point Count: **212**



	Nonlinear Trend		Linear Trend	
Velocity:	-0.58	in/yr	-0.41	in/yr
Acceleration:	-0.23	in/yr^2	0.00	in/yr^2

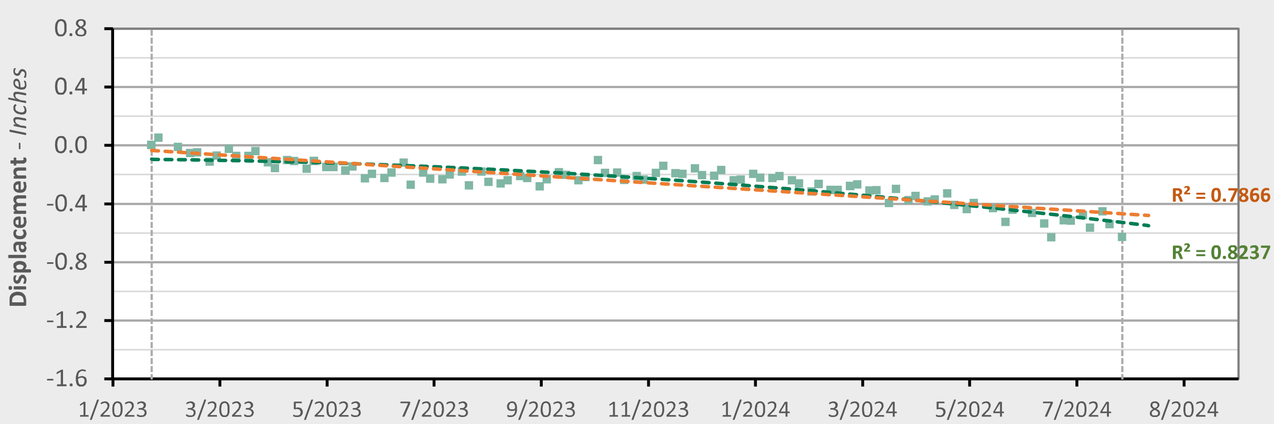
LOS Displacement Measurement
Nonlinear Trend Line (Quadratic Regression)
Linear Trend Line (Linear Regression)

AOI 7 *(PPG 7)* - Location Map



AOI 7 *(PPG 7)* - Displacement Time Series

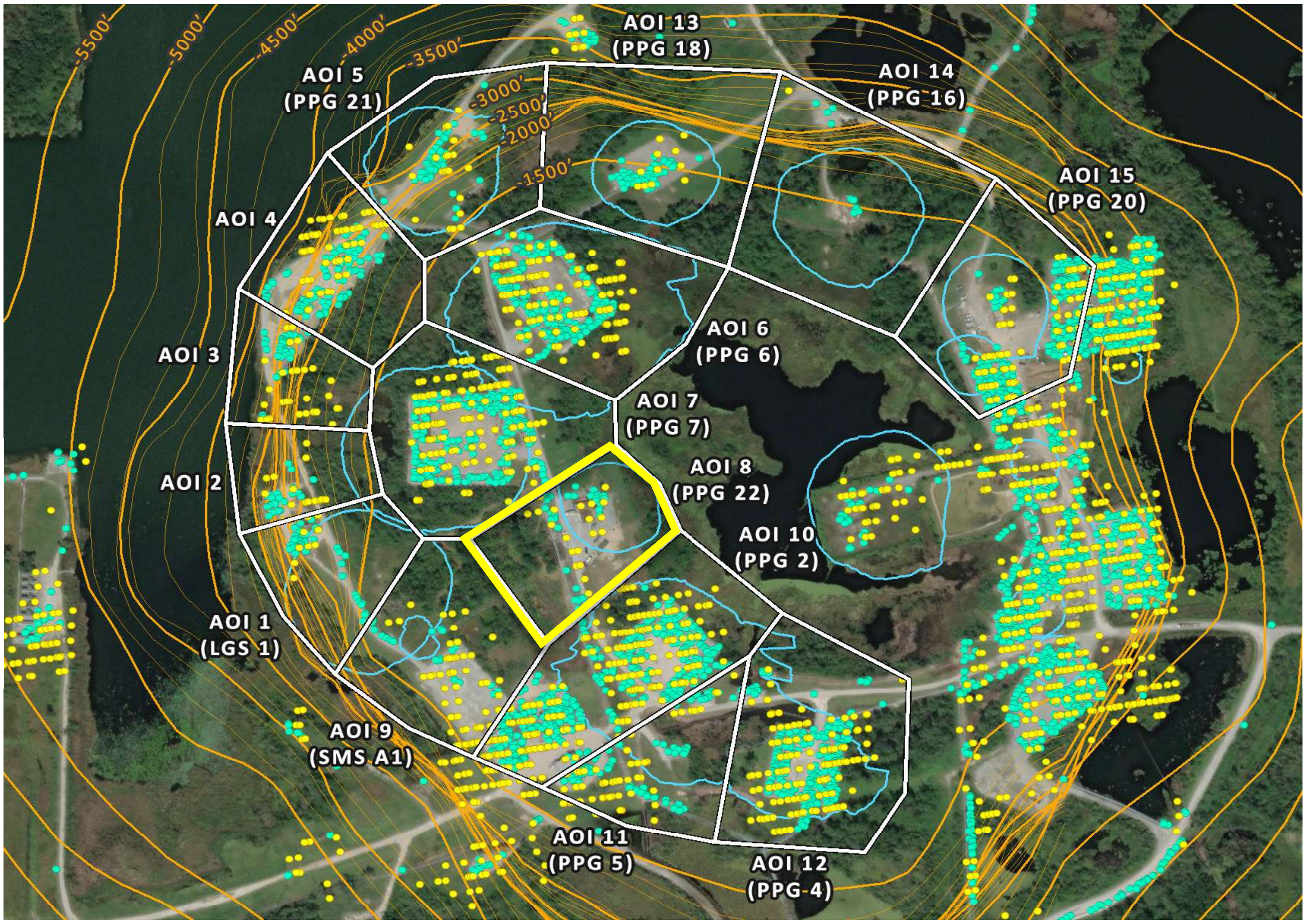
TSX/PAZ (7/27/2024) Point Count: **216**



	Nonlinear Trend		Linear Trend	
Velocity:	-0.53	in/yr	-0.29	in/yr
Acceleration:	-0.32	in/yr^2	0.00	in/yr^2

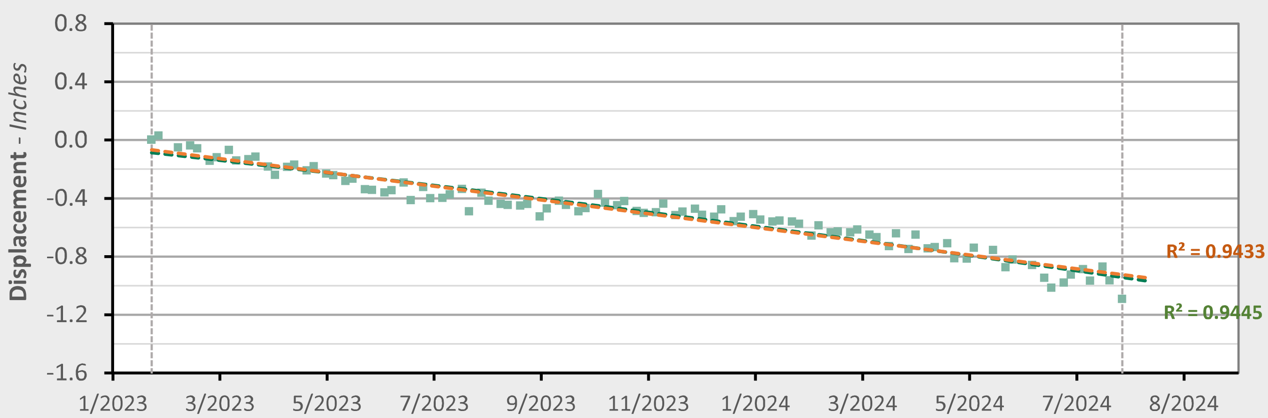
LOS Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 8 *(PPG 22)* - Location Map



AOI 8 *(PPG 22)* - Displacement Time Series

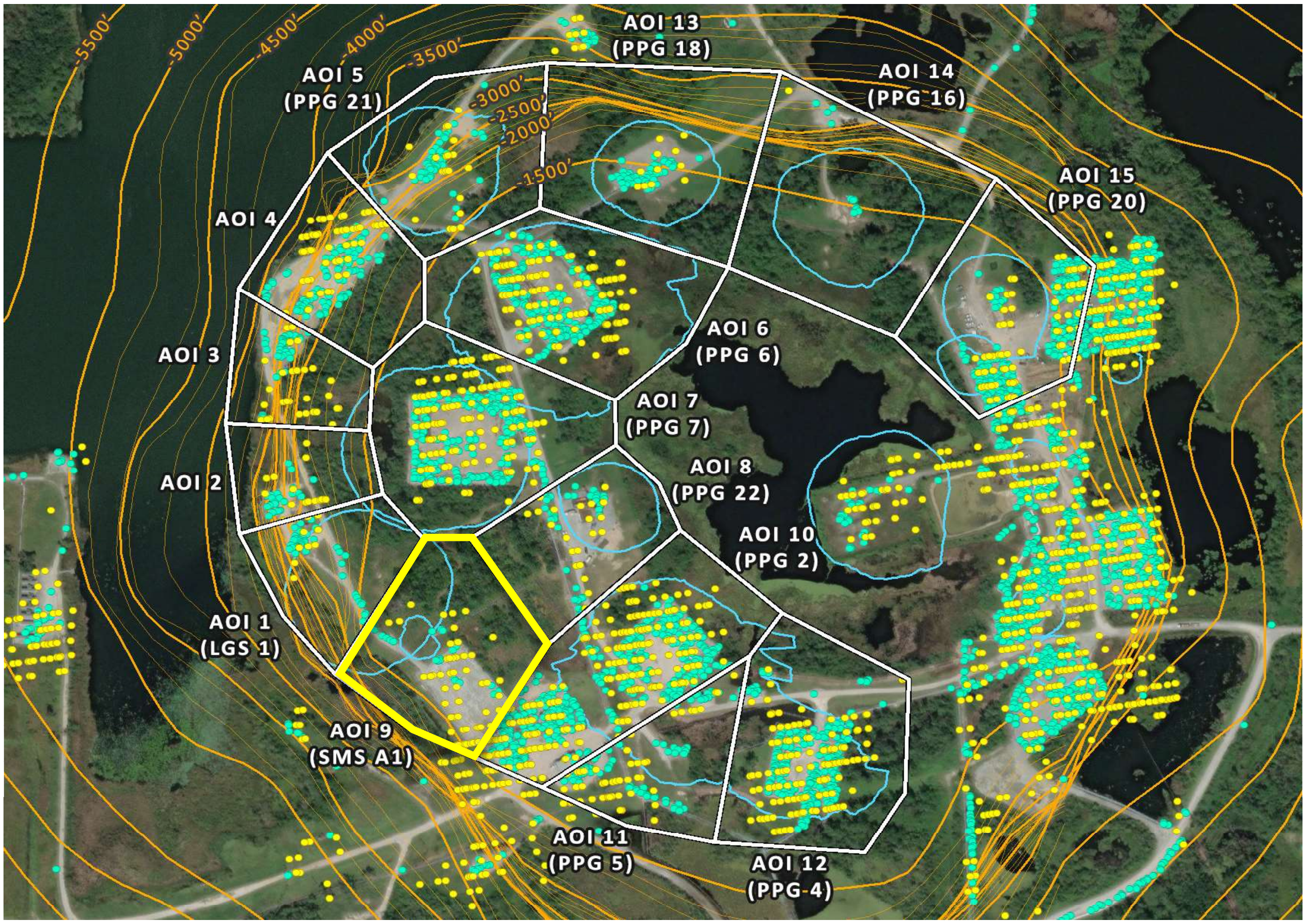
TSX/PAZ (7/27/2024) Point Count: 36



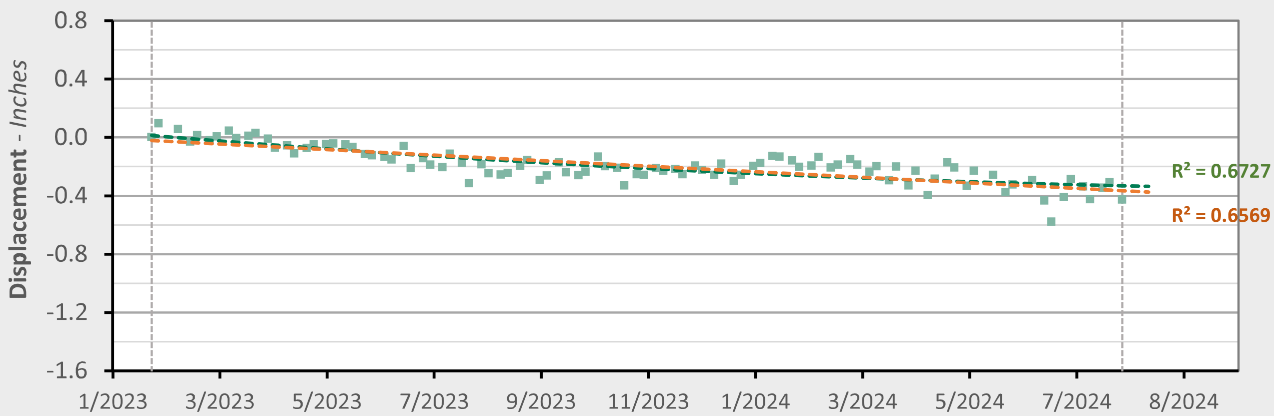
	Nonlinear Trend		Linear Trend	
Velocity:	-0.64	in/yr	-0.57	in/yr
Acceleration:	-0.10	in/yr^2	0.00	in/yr^2

LOS Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 9 *(PPG A1)* - Location Map



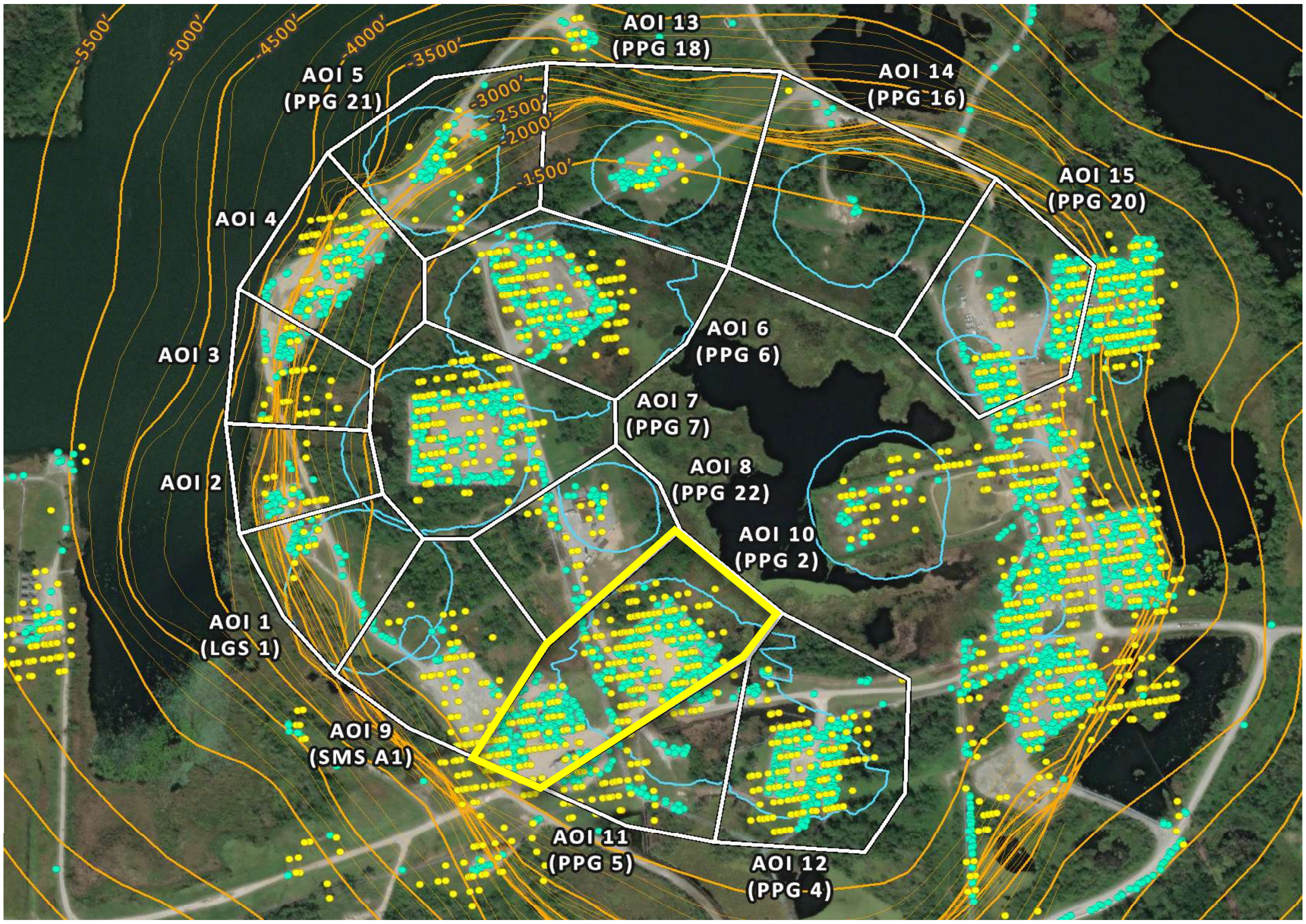
AOI 9 *(SMS A1)* - Displacement Time Series TSX/PAZ (7/27/2024) Point Count: 23



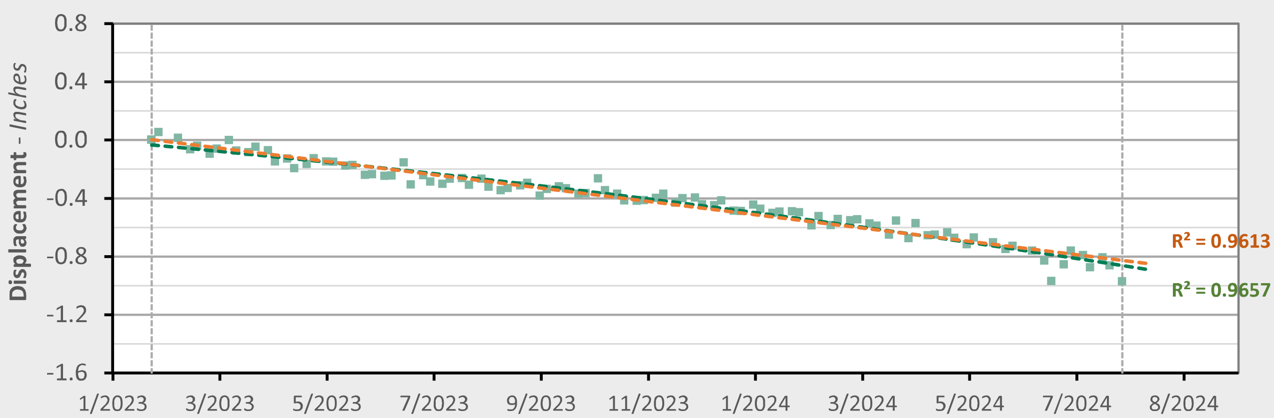
	Nonlinear Trend		Linear Trend	
Velocity:	-0.09	in/yr	-0.23	in/yr
Acceleration:	+0.18	in/yr^2	0.00	in/yr^2

LOS Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 10 *(PPG 2)* - Location Map



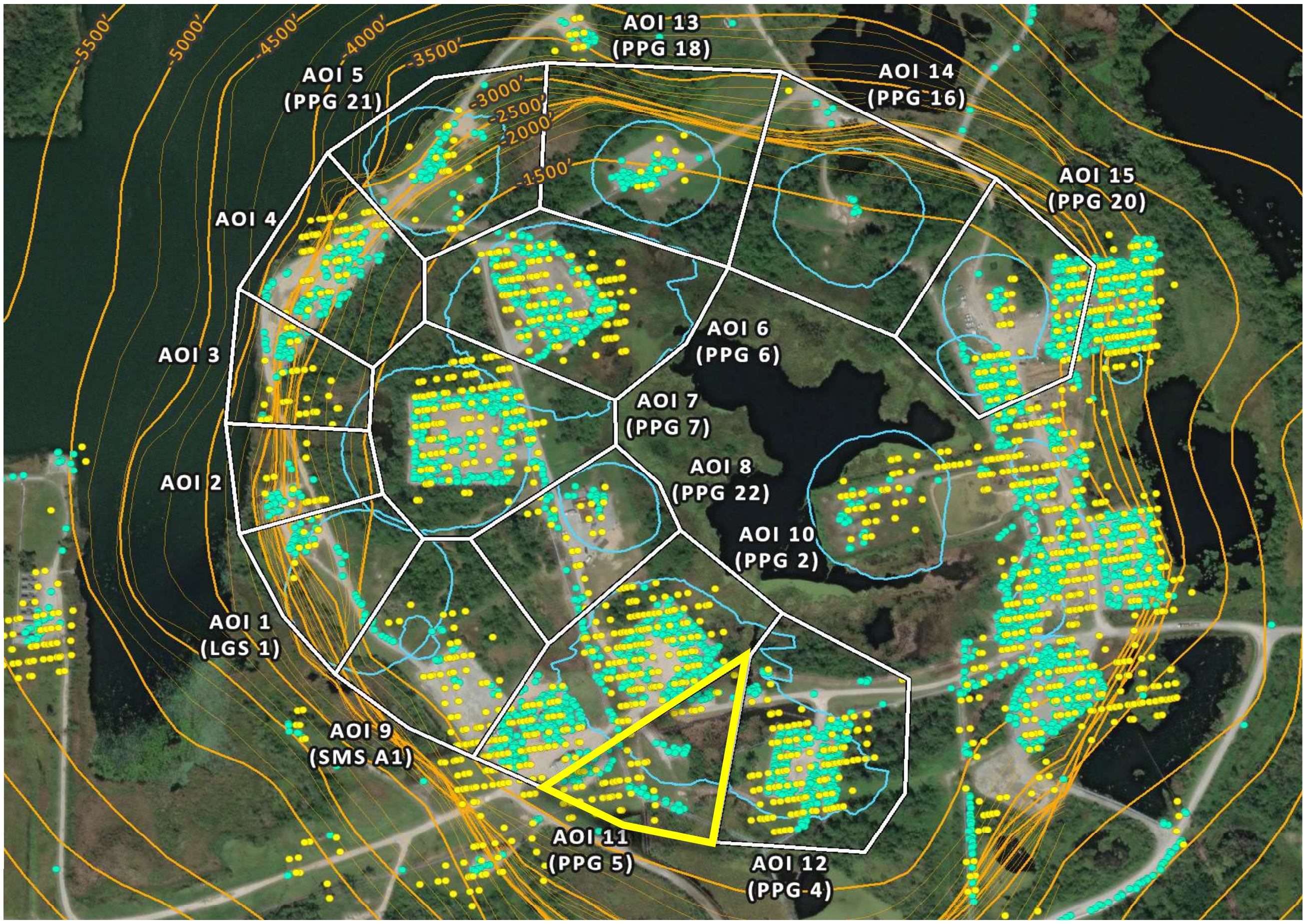
AOI 10 *(PPG 2)* - Displacement Time Series TSX/PAZ (7/27/2024) Point Count: 404



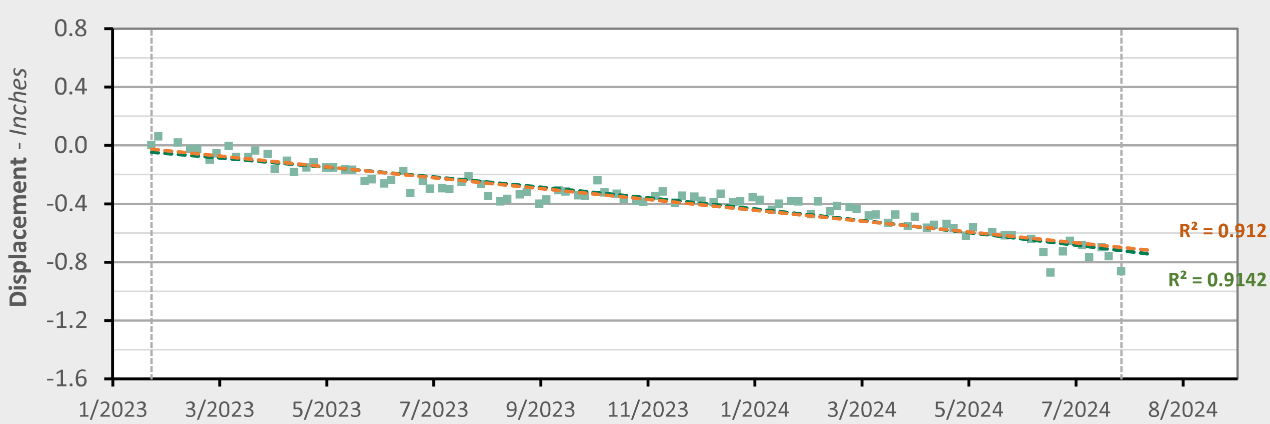
	Nonlinear Trend	Linear Trend
Velocity:	-0.69 in/yr	-0.55 in/yr
Acceleration:	-0.19 in/yr^2	0.00 in/yr^2

LOS Displacement Measurement
Nonlinear Trend Line (Quadratic Regression)
Linear Trend Line (Linear Regression)

AOI 11 *(PPG 5)* - Location Map



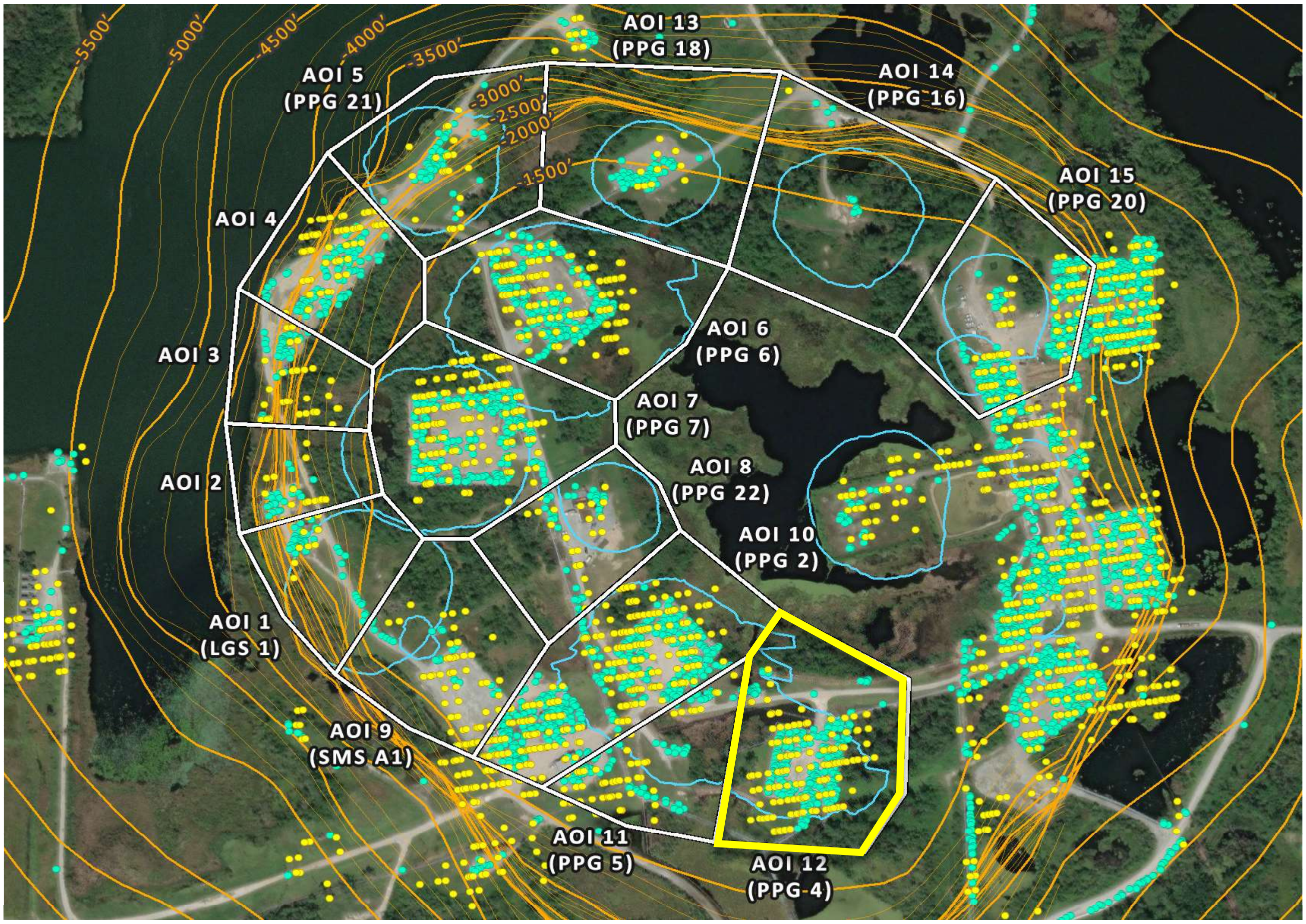
AOI 11 *(PPG 5)* - Displacement Time Series TSX/PAZ (7/27/2024) Point Count: 85



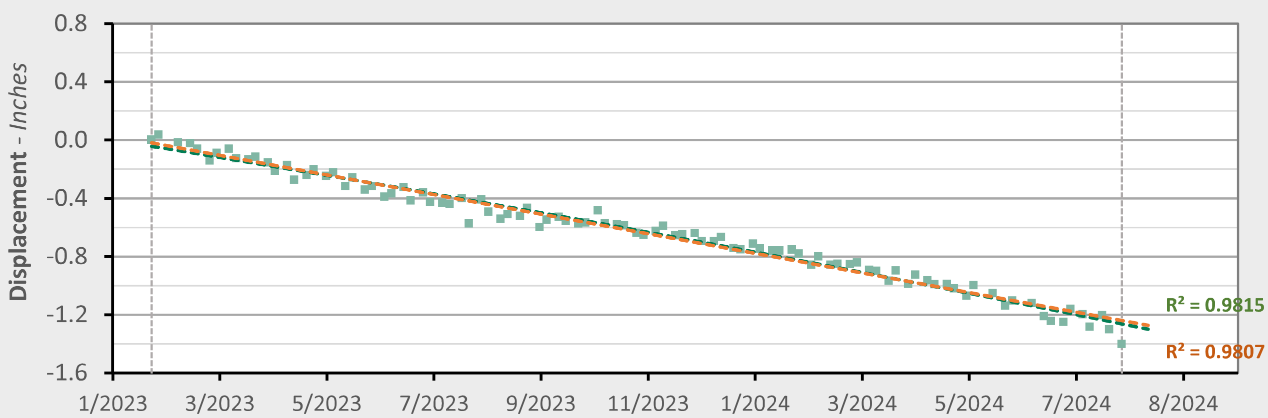
	Nonlinear Trend		Linear Trend	
Velocity:	-0.53	in/yr	-0.45	in/yr
Acceleration:	-0.11	in/yr^2	0.00	in/yr^2

LOS Displacement Measurement | Nonlinear Trend Line (Quadratic Regression) | Linear Trend Line (Linear Regression)

AOI 12 *(PPG 4)* - Location Map



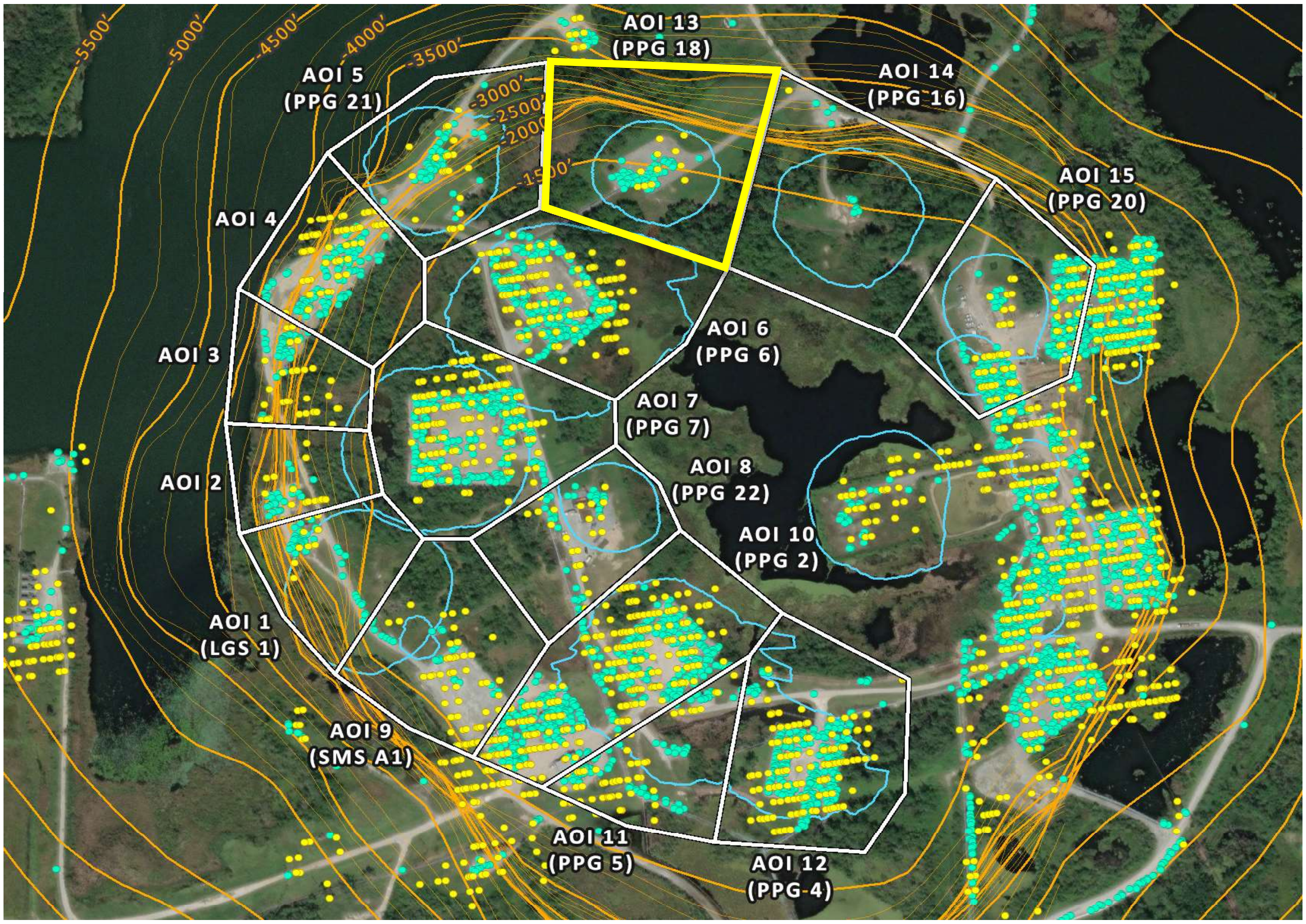
AOI 12 *(PPG 4)* - Displacement Time Series TSX/PAZ (7/27/2024) Point Count: 262



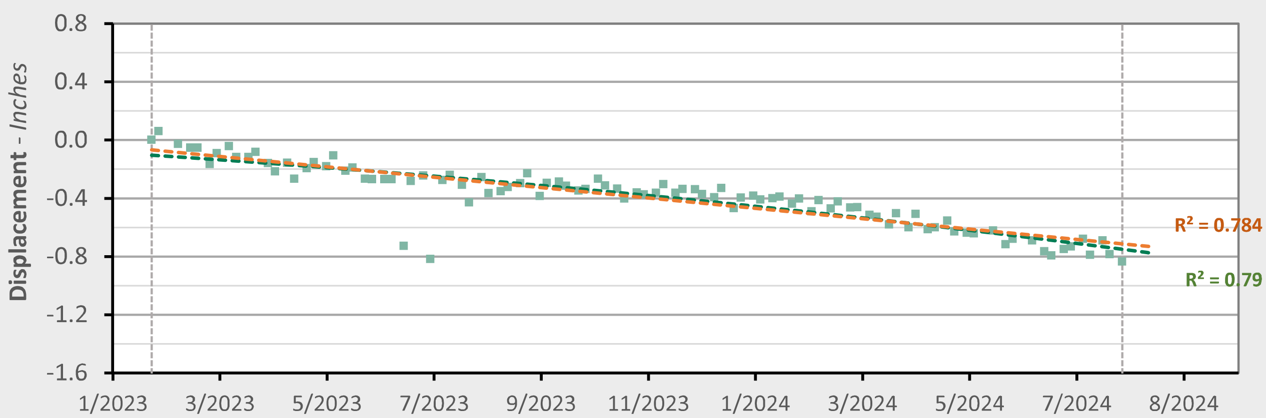
	Nonlinear Trend		Linear Trend	
Velocity:	-0.90	in/yr	-0.81	in/yr
Acceleration:	-0.12	in/yr^2	0.00	in/yr^2

LOS Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 13 *(PPG 18)* - Location Map



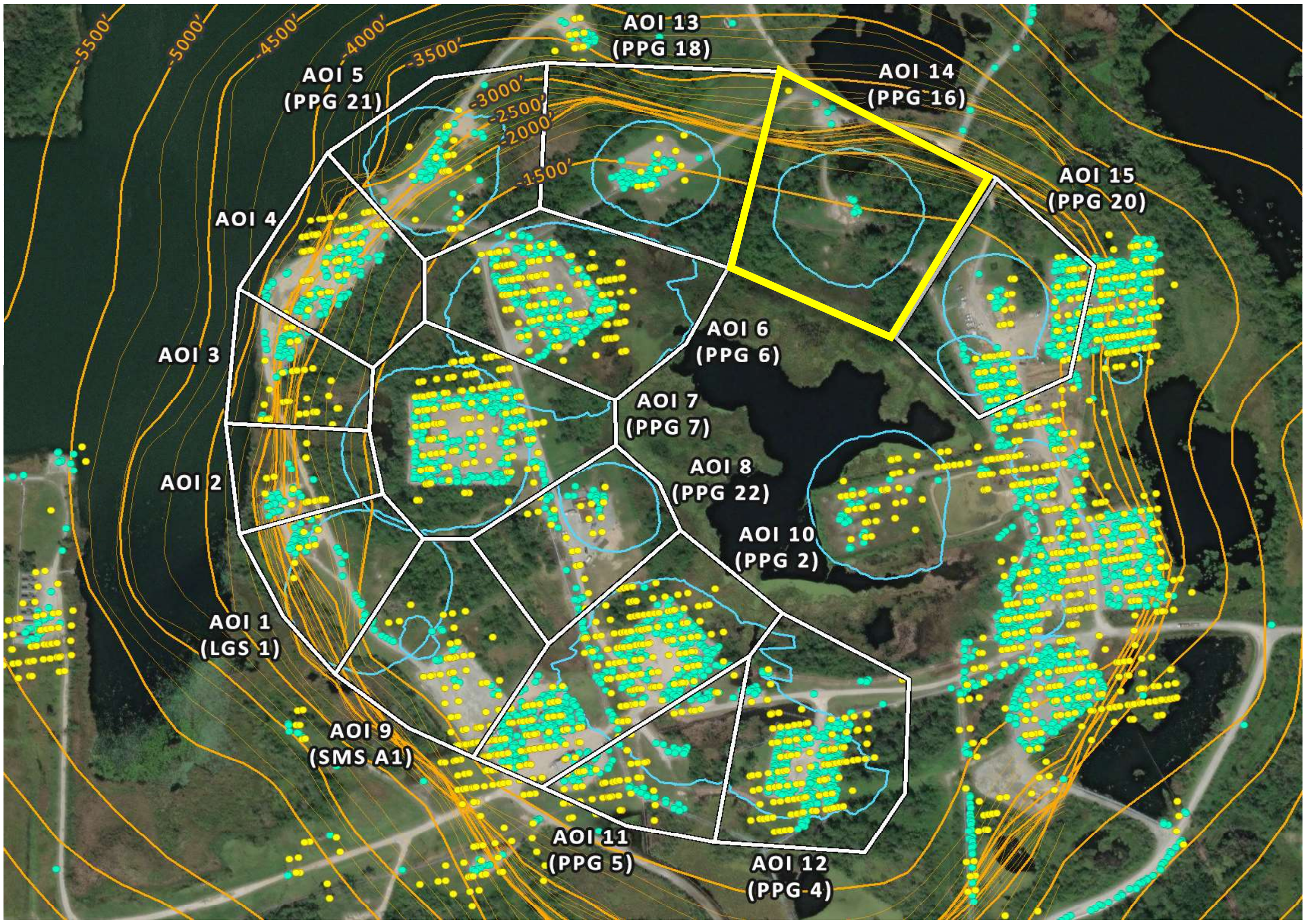
AOI 13 *(PPG 18)* - Displacement Time Series TSX/PAZ (7/27/2024) Point Count: 52



	Nonlinear Trend		Linear Trend	
Velocity:	-0.57	in/yr	-0.43	in/yr
Acceleration:	-0.19	in/yr^2	0.00	in/yr^2

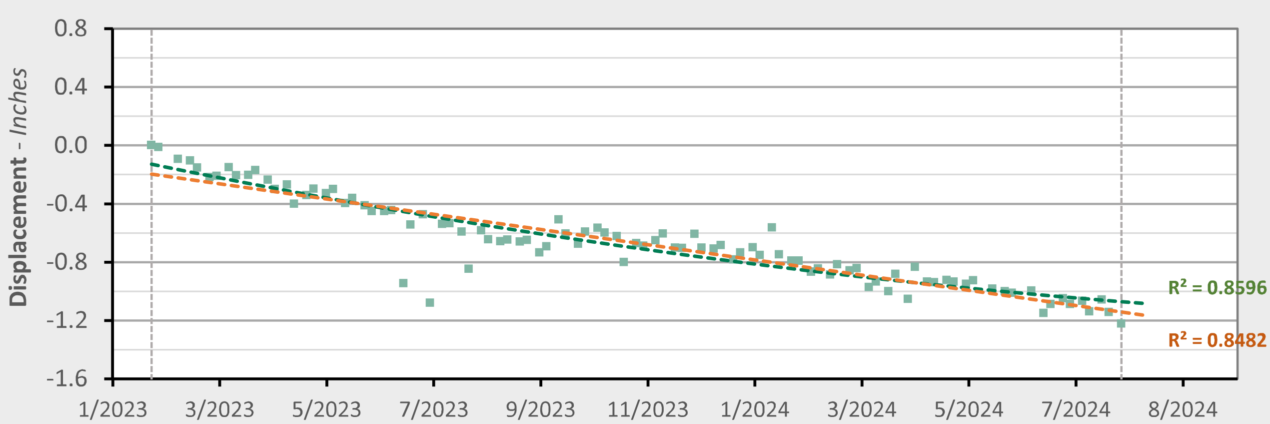
LOS Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 14 *(PPG 16)* - Location Map



AOI 14 *(PPG 16)* - Displacement Time Series

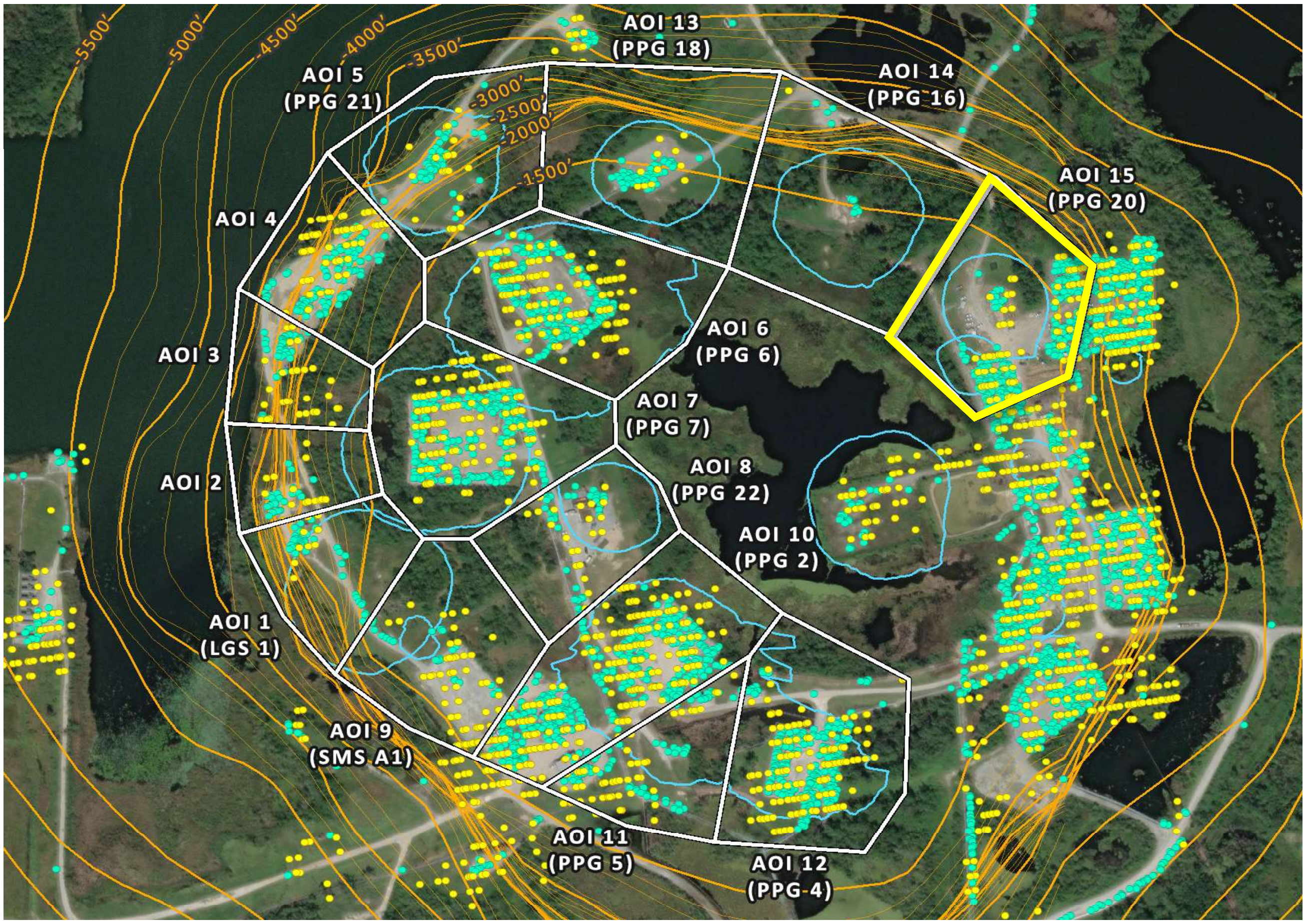
TSX/PAZ (7/27/2024) Point Count: 11



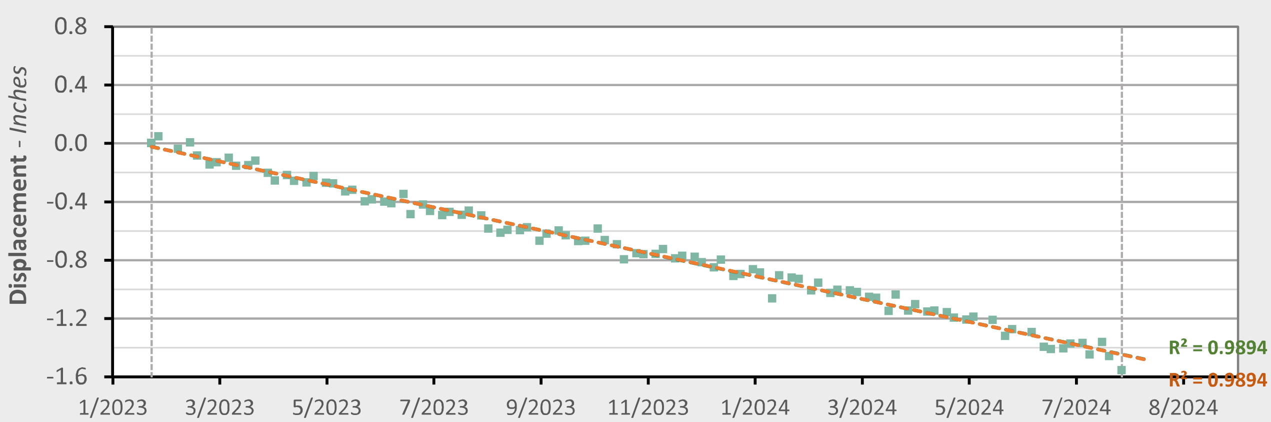
	Nonlinear Trend	Linear Trend
Velocity:	-0.35 in/yr	-0.63 in/yr
Acceleration:	+0.37 in/yr²	0.00 in/yr²

LOS Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 15 *(PPG 20)* - Location Map



AOI 15 *(PPG 20)* - Displacement Time Series TSX/PAZ (7/27/2024) Point Count: 224



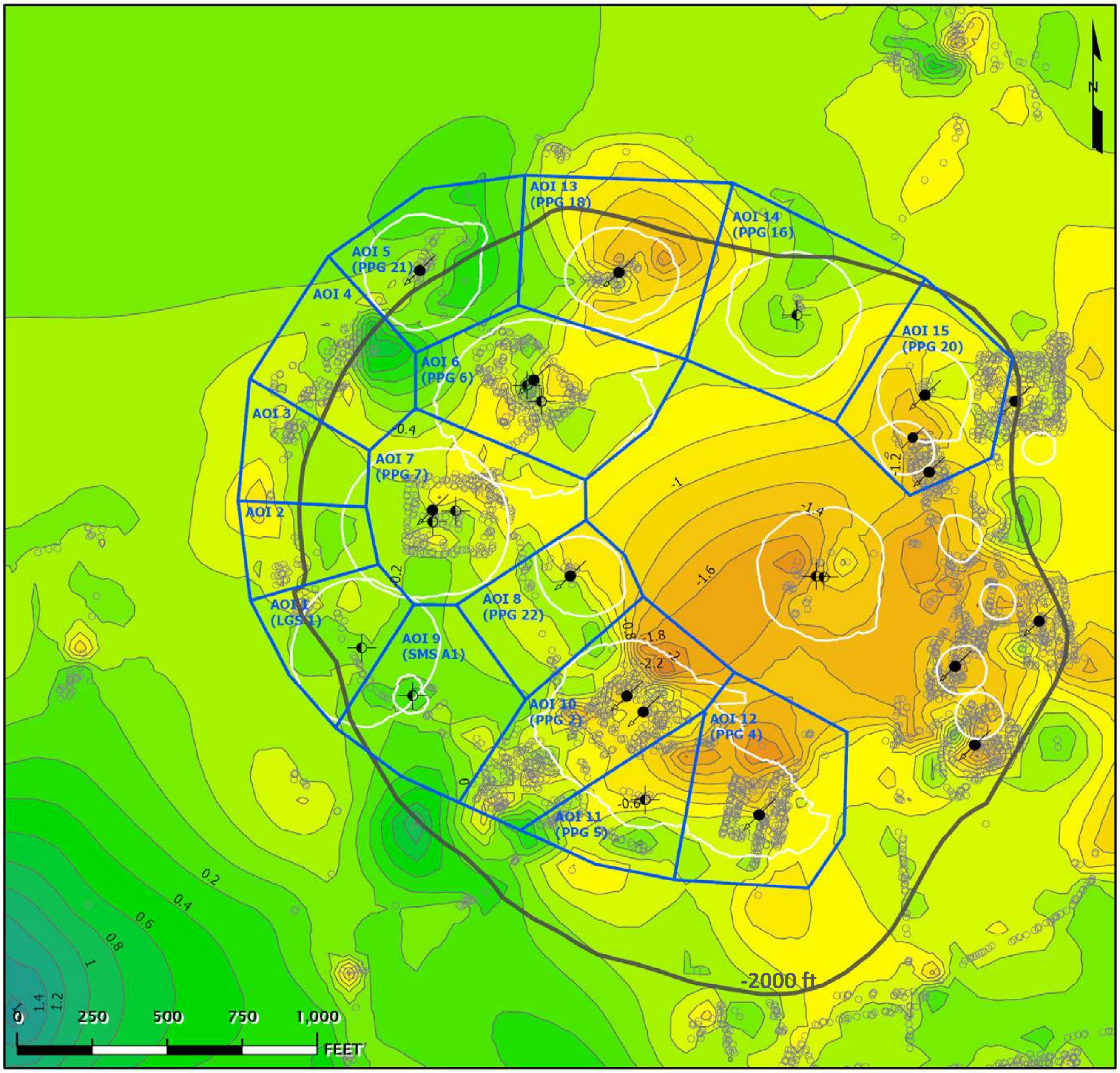
	Nonlinear Trend		Linear Trend	
Velocity:	-0.94	in/yr	-0.94	in/yr
Acceleration:	+0.00	in/yr^2	0.00	in/yr^2

LOS Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

TSX/PAZ Data (01/24/2023 - 07/27/2024)

Nonlinear Velocity Contours

As of date: 07/27/2024



-3.0 -2.0 -1.0 0.0 +1.0 +2.0 +3.0 Inches/year

AOI Boundary | InSAR LOS Measurement Point | Contour (0.2)

Historical Cavern Extent | Top of Dome (-2000 ft Contour)

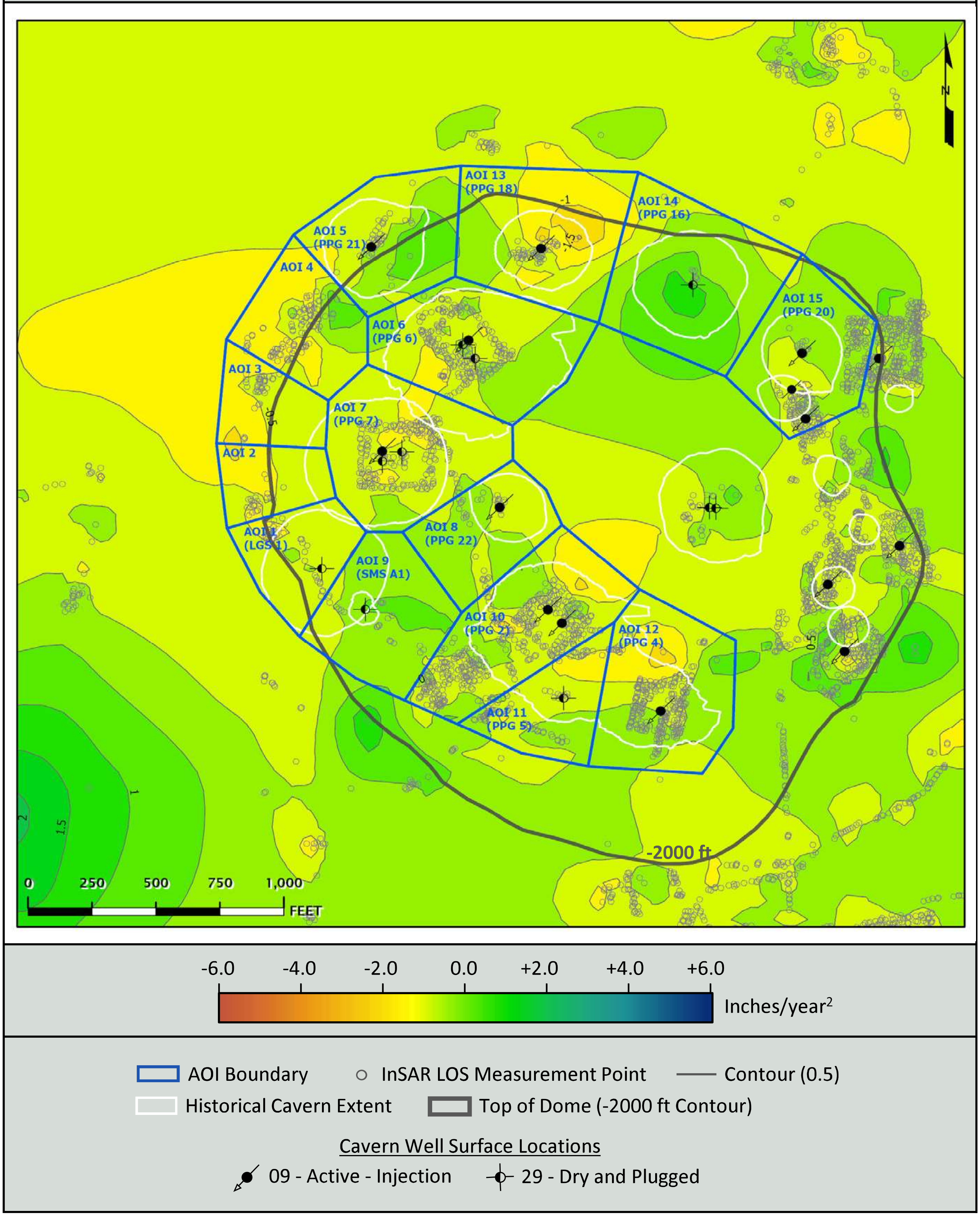
Cavern Well Surface Locations

09 - Active - Injection | 29 - Dry and Plugged

TSX/PAZ Data (01/24/2023 - 07/27/2024)

Nonlinear Acceleration Contours

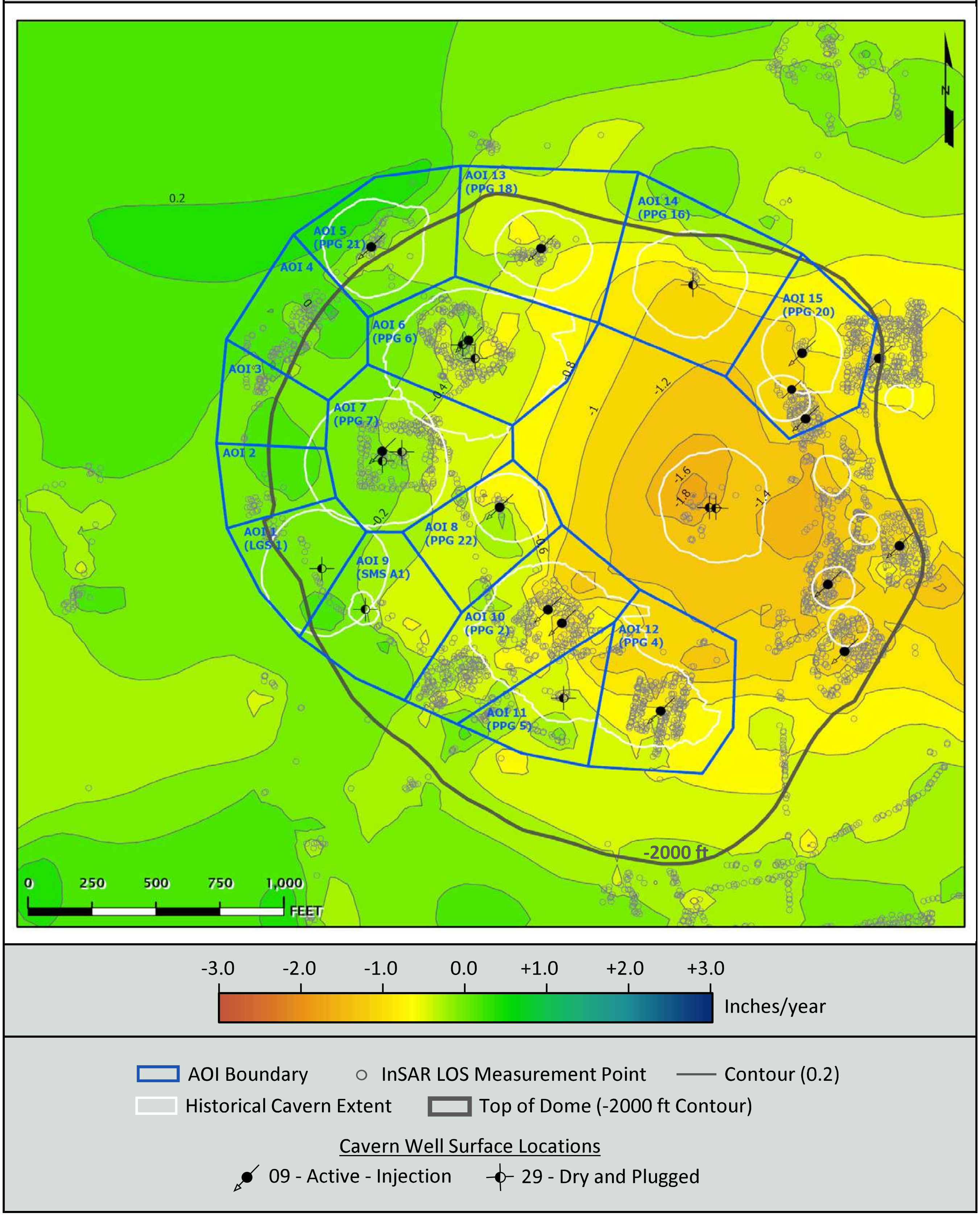
Date range: 01/24/2023 - 07/27/2024



TSX/PAZ Data (01/24/2023 - 07/27/2024)

Linear Velocity Contours

Date range: 01/24/2023 - 07/27/2024



ATTACHMENT D

Vertical & East-West 2D InSAR report - July 27, 2024

Vertical & E-W 2D Update

Continuous InSAR Monitoring of Ground Displacement At Westlake Caverns and Western Dome Flank

Sulphur Mines Salt Dome

Prepared for:
Westlake Chemical

Prepared by:
Lonquist & Co., LLC
8591 United Plaza Blvd.
Suite 280
Baton Rouge, LA 70809

Dataset
Satellite Source
Sentinel-1 & TerraSAR-X - PAZ Constellation
Most Recent Image Date
Saturday, July 27, 2024

Analysis Report Date:

August 12, 2024

Dataset Information

Satellite Source	Sentinel-1 & TerraSAR-X - PAZ Constellation
Update Frequency	12 days
Most Recent Image Date	Saturday, July 27, 2024
Dataset Image Count	125
Dataset Time Range	January 24, 2023 - July 27, 2024
Dataset Length	1.51 Years
Measurement Directions	Vertical and East-West

Analysis Methodology

Time Series Charts

Trend lines were calculated for the averaged vertical and east-west displacement values within each AOI. Both a nonlinear (quadratic) and linear regression were applied to each AOI point group to identify rates of change in LOS displacement. These trends are displayed in the Time Series section of this report.

Contour Maps

A nonlinear (quadratic) and linear trend was also calculated for each individual measurement point across the analysis region. Nonlinear trend values for each point were used to generate Velocity and Acceleration contour maps to convey the spatial distribution of the calculated movement. The linear trend values for each point (which lack an acceleration component) were used to generate an additional Velocity contour map.

Rate Interpretation

For the vertical data, positive velocity values indicate uplift and negative velocity values indicate subsidence. Positive acceleration values indicate increasing rates of uplift or slowing rates of subsidence, while negative acceleration values indicate slowing rates of uplift or increasing rates of subsidence. For the east-west data, positive velocity values indicate eastward horizontal movement and negative velocity values indicate horizontal westward movement. Positive acceleration values indicate increasing rates of eastward movement or decreasing rates of westward movement, while negative acceleration values indicate increasing rates of westward movement or decreasing rates of eastward movement.

Observations

To-date there have been no acute deviations from established subsidence trends in the areas investigated.

The calculated vertical displacement values indicate that subsidence is occuring with near-linear trends in all AOIs where data is present. Minor positive acceleration (slowing subsidence) is present all of the calculated nonlinear AOI trends.

The calculated east-west dispacement values generally indicate horizontal movement toward the dome center with the greatest rates of eastward movement occuring in the westernmost AOIs and the greatest rate of westward movement occuring in the easternmost AOI. All AOIs indicate varying amounts of negative acceleration (slower eastward or faster westward displacment) with the most pronounced values occuring in AOI 1 and AOI 3. This likely correlates to the minor increases in negative acceleration recently noted in the TSX/PAZ LOS dataset reports.

Date Signed: August 12, 2024
Austin, Texas

Nathaniel L. Byars, P.E.
Principal Engineer
Louisiana License No. 40697

InSAR Data Sources

InSAR Data

Interferometric Synthetic Aperture Radar (InSAR) is the most well established method to continually evaluate small, normally undetectable, ground movement over a large area. Radar imagery collected via satellites over successive orbital passes is used to identify and define measurement points on the ground. Objects or ground features providing a stable reflection of radar energy such as buildings, roads, and infrastructure produce the highest quality measurement points. InSAR analysis identifies the change in distance between the satellite and each measurement point over time relative to a stable reference point within the imaged area.

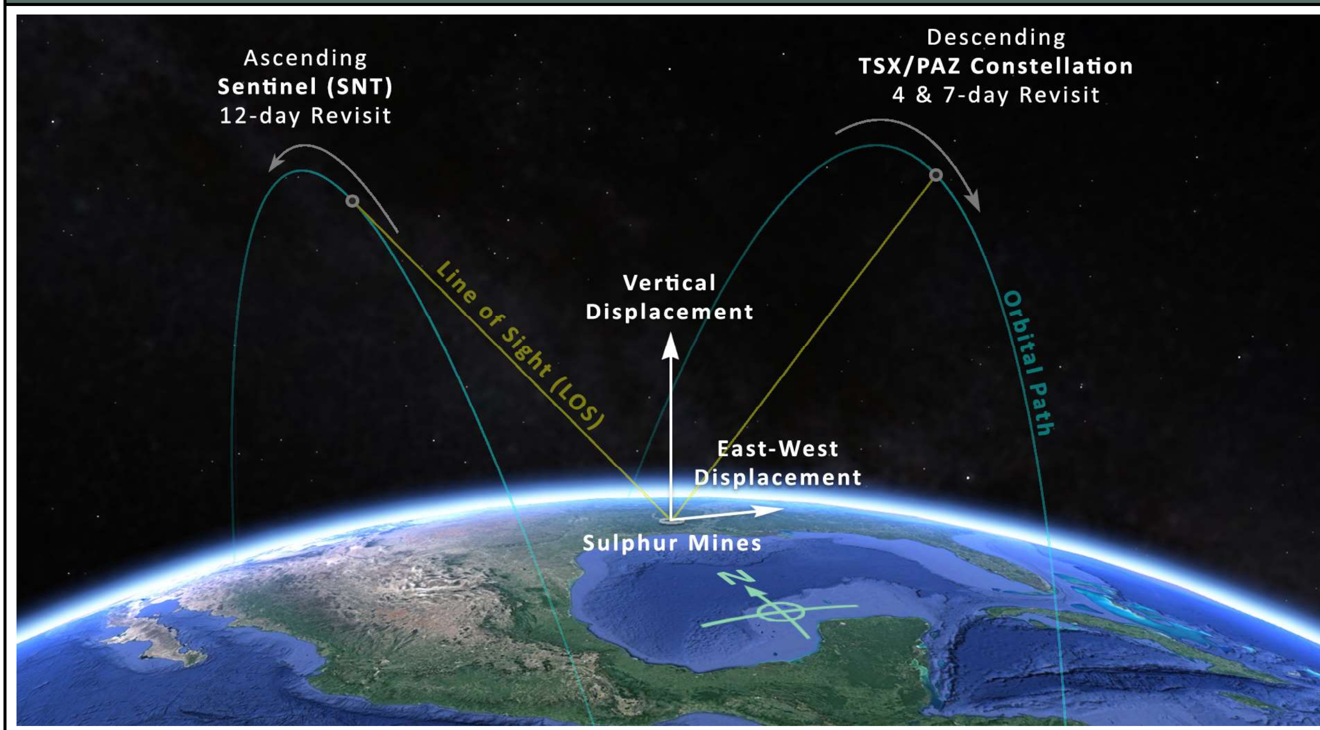
Satellite Sources

Two InSAR datasets are being used to evaluate subsidence over the Sulphur Mines Salt Dome. These datasets provide Line-of-Sight (LOS) displacment measurements from both ascending and descending orbits. An ascending orbit denotes the satellite's longitudinal course from south to north as it passes over the site, while a descending orbit denotes the satellite is moving from north to south.

The first dataset comes from a low-resolution Sentinel-1 (SNT) satellite on an ascending orbit that captures data from the west of the site on a 12-day frequency. The second comes from a pair of high resolution satellites that share the same descending orbit and capture data from east of the site. These are a TSX satellite and the PAZ satellite (TSX/PAZ constellation), both with an 11-day revisit frequency. Their orbits are offset with the PAZ satellite passing over the site 4 days after the TSX satellite.

Each instance of data capture in either the SNT or TSX/PAZ constellation is used to generate 2D (two-dimensional) displacement values in the vertical and east-west directions for each measurement point within the 2D data grid. The image below depicts the orbital paths of the satellites in relation to the Sulphur Mines Salt Dome as well as the 2D components of the calculated displacement.

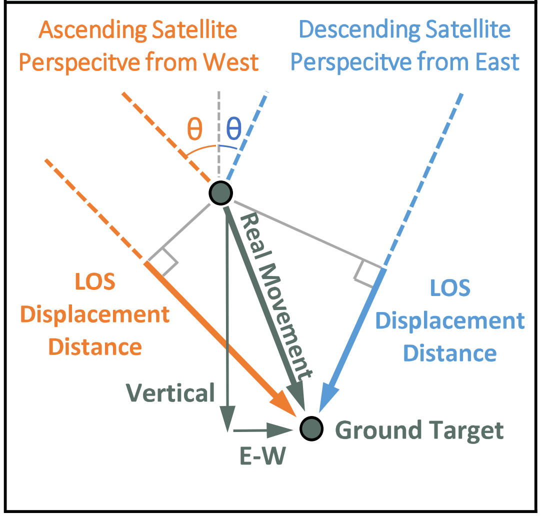
Satellite Orbital Diagram



InSAR 2D Vertical and East-West Data

LOS (line-of-sight) displacement measurements, which refer to a change in distance between the satellite sensor and the ground target, are used to triangulate the real movement along the 2D plane defined by the satellite positions and the ground target. The diagram to the right illustrates the geometric relationship between the Real Movement of a ground target, the LOS displacement measurements from two different satellite viewing directions, and the resulting vertical and east-west components of calculated 2D displacement. Ground targets are not consistent between LOS datasets so these calculations are performed on averaged LOS data within 82-ft square cells. One 2D measurement point is generated within each cell where data from both LOS sources are present.

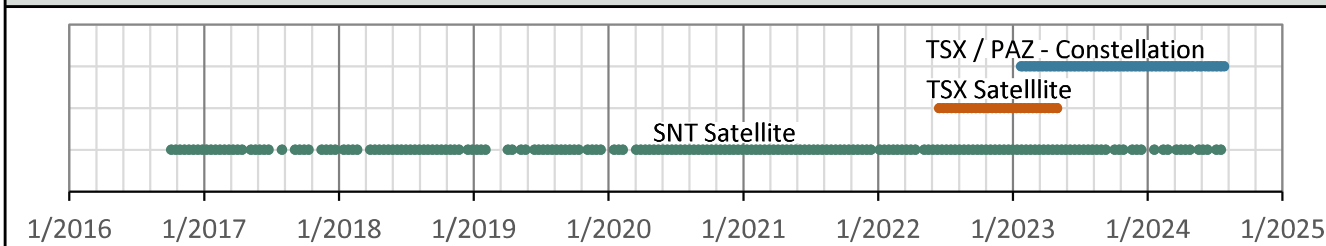
<– West **Side View** East–>



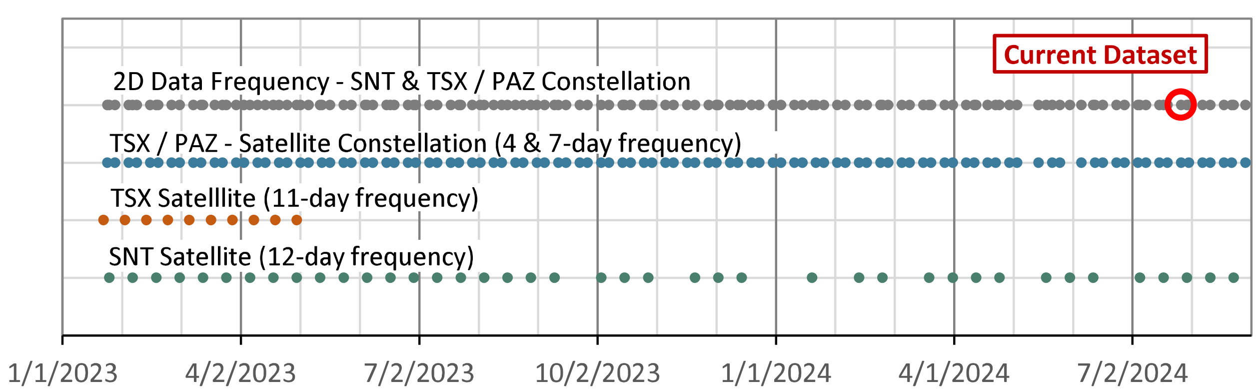
Satellite Properties & Image Frequency

Satellite and Data Properties	SNT	TSX/PAZ Constellation
Band (Wavelength)	C-band (2.20 in)	X-band (1.22 in)
Track	T136	T67 & T120
Pixel resolution	65 x 16 ft	3 x 3 ft
Revisit frequency	12 days	4 & 7 days
Orbit (LOS Angle, θ)	Ascending (43^o)	Descending (37^o)
Data Start Date	10/4/2016	1/24/2023
Measurement error range	± 0.20 in	± 0.03 in

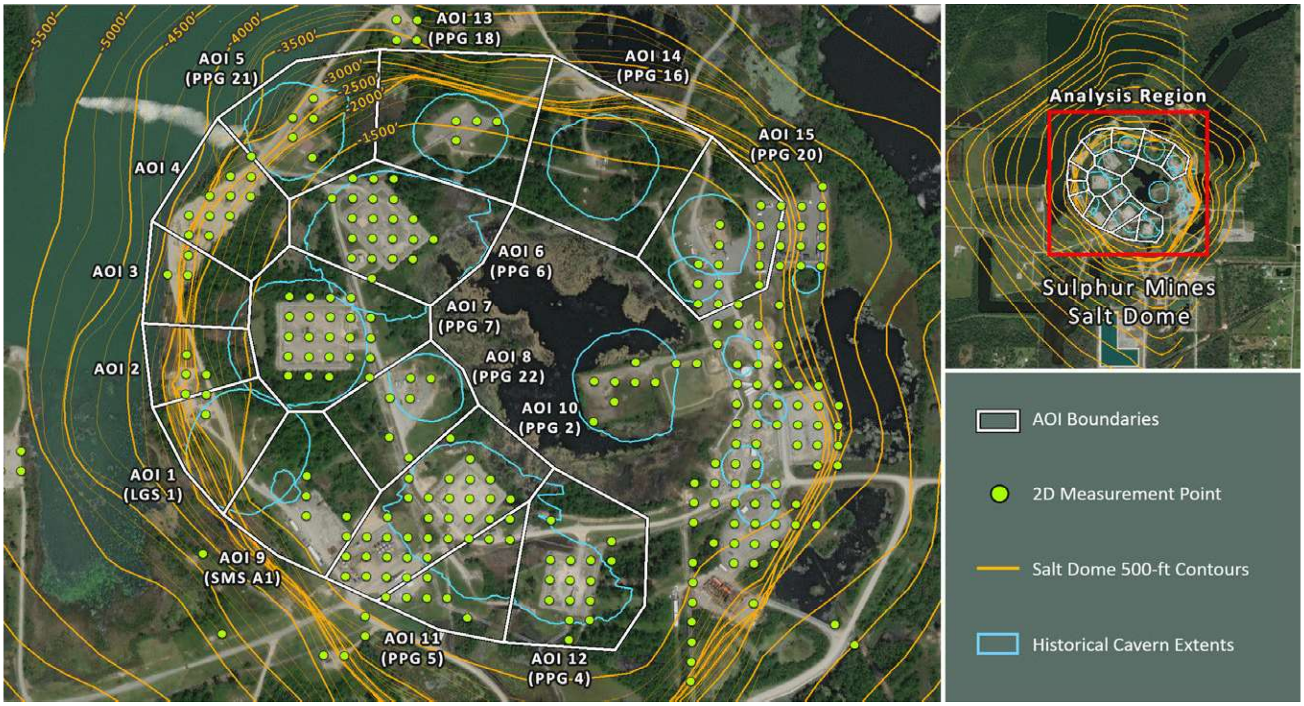
LOS Measurement History



2D Measurement Frequency



AOI Boundaries & 2D InSAR Measurement Points

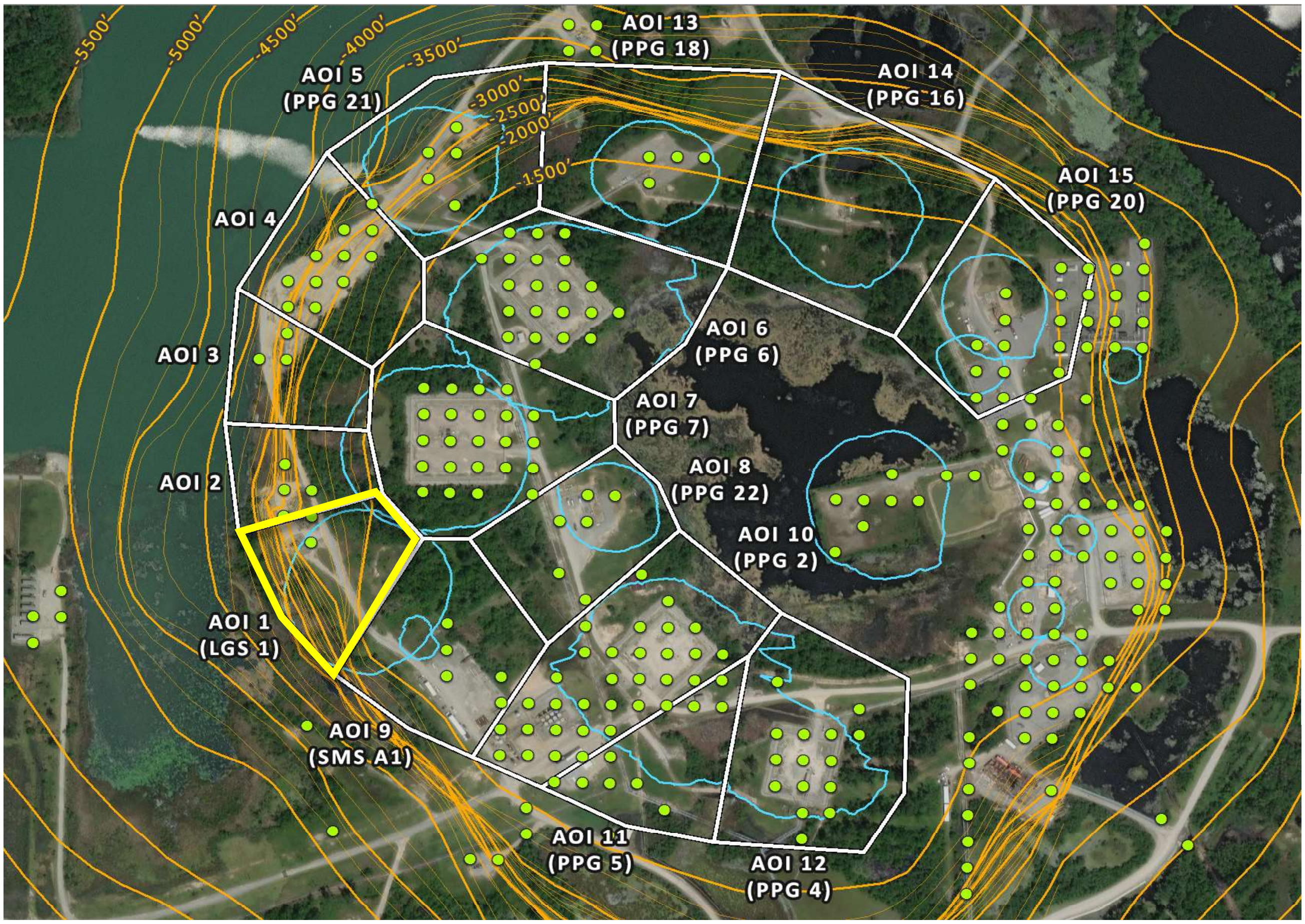


Subsidence Monitoring Areas of Interest (AOIs)

To visually convey and evaluate trend consistency for the Vertical displacement time series of each ground target, measurment points were grouped and their displacement values were averaged. The point groups are referred to as Areas of Interest (AOIs) in this analysis and their boundaries are depicted on the above map. The below table lists the Vertical trend values calculated in each AOI for the dataset evaluated in this report.

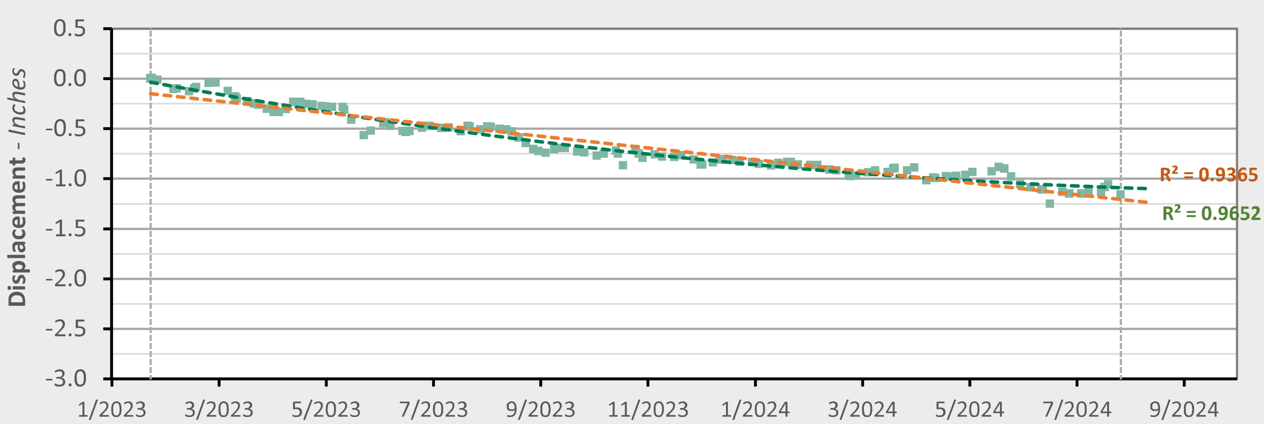
AOI Name	Vertical (7/27/2024)	Vertical Velocity (in/yr)		Vertical Acceleration (in/yr²)	
	Point Count	Nonlinear	Linear	Nonlinear	Linear
AOI 1 *(LGS 1)*	2	-0.23	-0.70	+0.63	0.00
AOI 2	4	-0.47	-0.60	+0.16	0.00
AOI 3	3	-0.31	-0.64	+0.44	0.00
AOI 4	11	-0.28	-0.53	+0.33	0.00
AOI 5 *(PPG 21)*	5	-0.33	-0.57	+0.32	0.00
AOI 6 *(PPG 6)*	21	-0.72	-0.90	+0.23	0.00
AOI 7 *(PPG 7)*	23	-0.72	-0.96	+0.32	0.00
AOI 8 *(PPG 22)*	6	-0.87	-1.24	+0.49	0.00
AOI 9 *(SMS A1)*	5	-0.45	-0.98	+0.70	0.00
AOI 10 *(PPG 2)*	32	-0.87	-1.11	+0.31	0.00
AOI 11 *(PPG 5)*	9	-0.64	-0.94	+0.39	0.00
AOI 12 *(PPG 4)*	15	-0.76	-1.11	+0.47	0.00
AOI 13 *(PPG 18)*	4	-0.39	-0.71	+0.42	0.00
AOI 14 *(PPG 16)*	0	N/A	N/A	N/A	N/A
AOI 15 *(PPG 20)*	14	-0.60	-0.93	+0.43	0.00

AOI 1 *(LGS 1)* - Location Map



AOI 1 *(LGS 1)* - Vertical Time Series

Vertical (7/27/2024) Point Count: **2**



	Nonlinear Trend		Linear Trend	
Velocity:	-0.23	in/yr	-0.70	in/yr
Acceleration:	+0.63	in/yr^2	0.00	in/yr^2

2D Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

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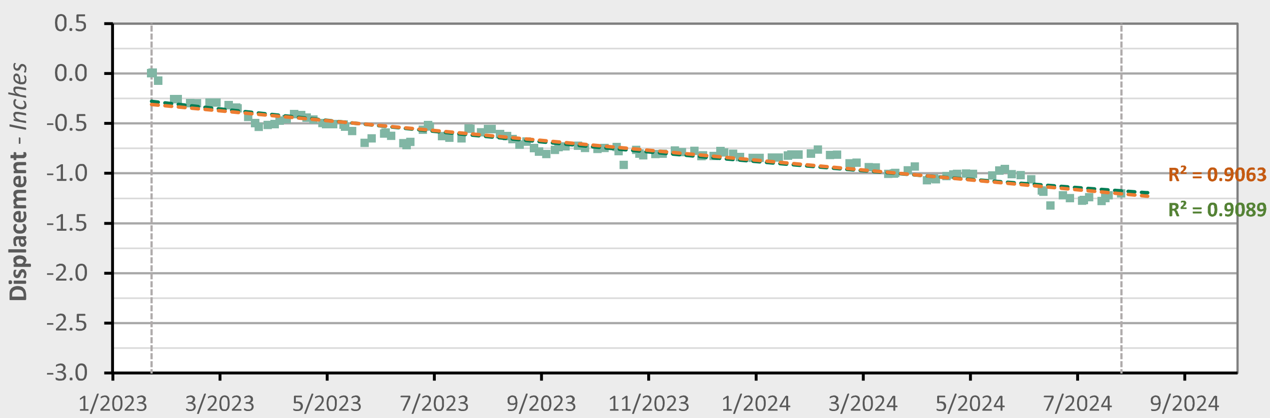
AOI 2 - Location Map

AOI 2 - Vertical Time Series

Vertical (7/27/2024) Point Count: 4



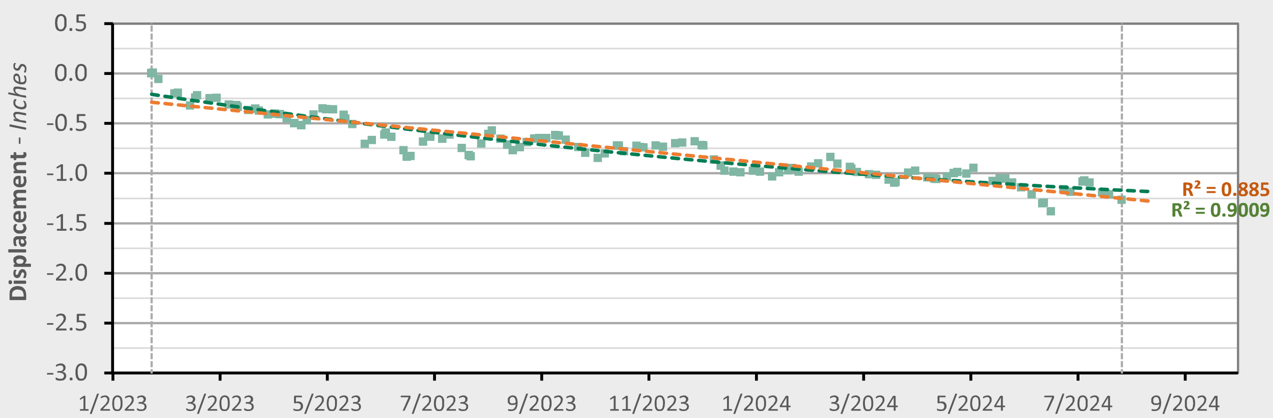
	Nonlinear Trend		Linear Trend	
Velocity:	-0.47	in/yr	-0.60	in/yr
Acceleration:	+0.16	in/yr^2	0.00	in/yr^2

2D Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 3 - Location Map

AOI 3 - Vertical Time Series

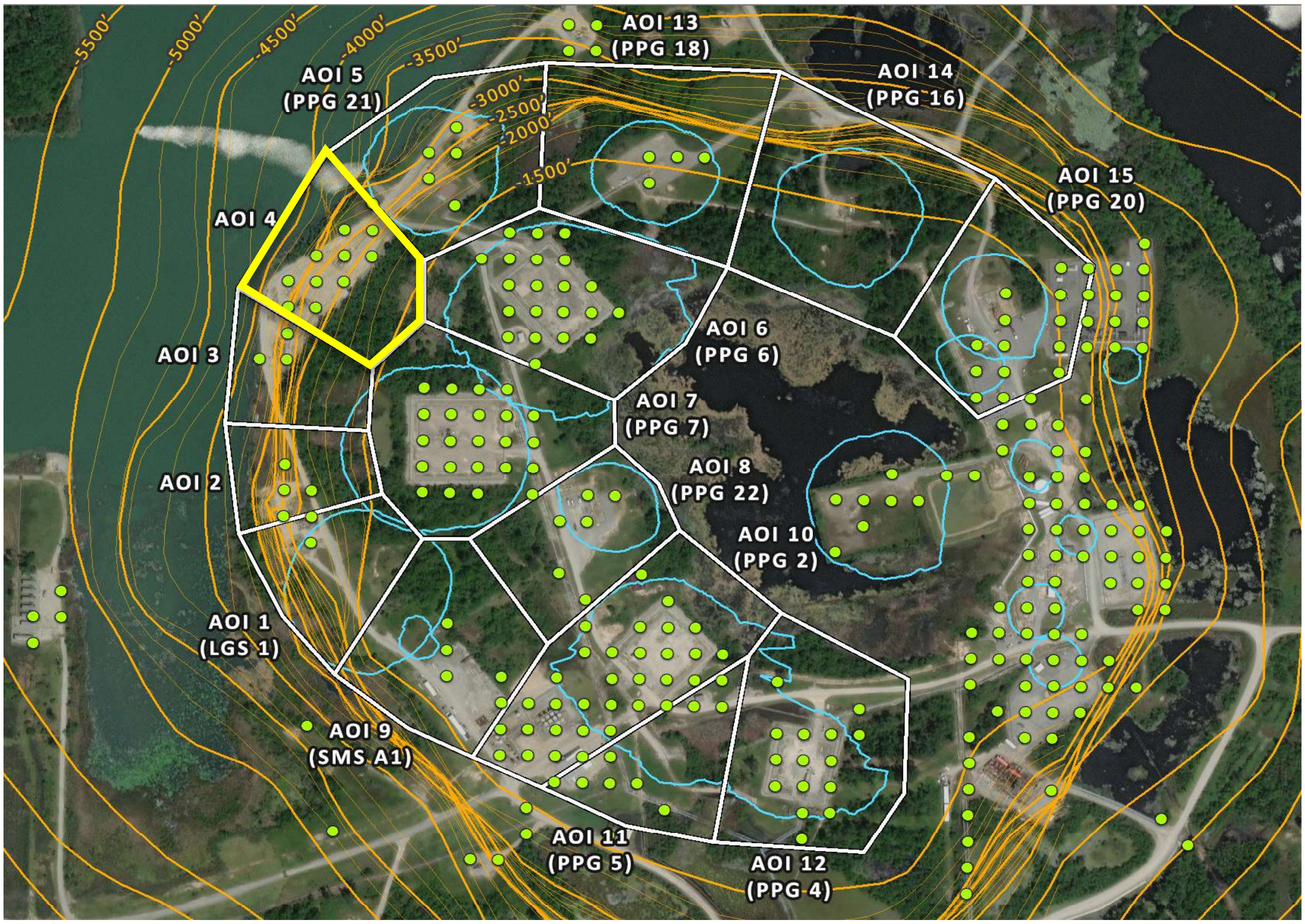
Vertical (7/27/2024) Point Count: 3



	Nonlinear Trend		Linear Trend	
Velocity:	-0.31	in/yr	-0.64	in/yr
Acceleration:	+0.44	in/yr^2	0.00	in/yr^2

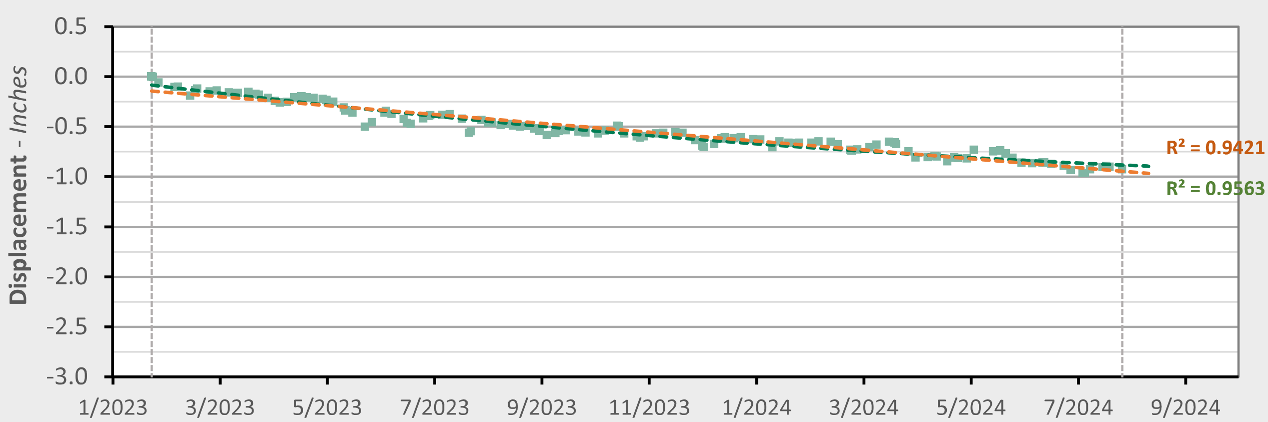
2D Displacement Measurement | Nonlinear Trend Line (Quadratic Regression) | Linear Trend Line (Linear Regression)

AOI 4 - Location Map



AOI 4 - Vertical Time Series

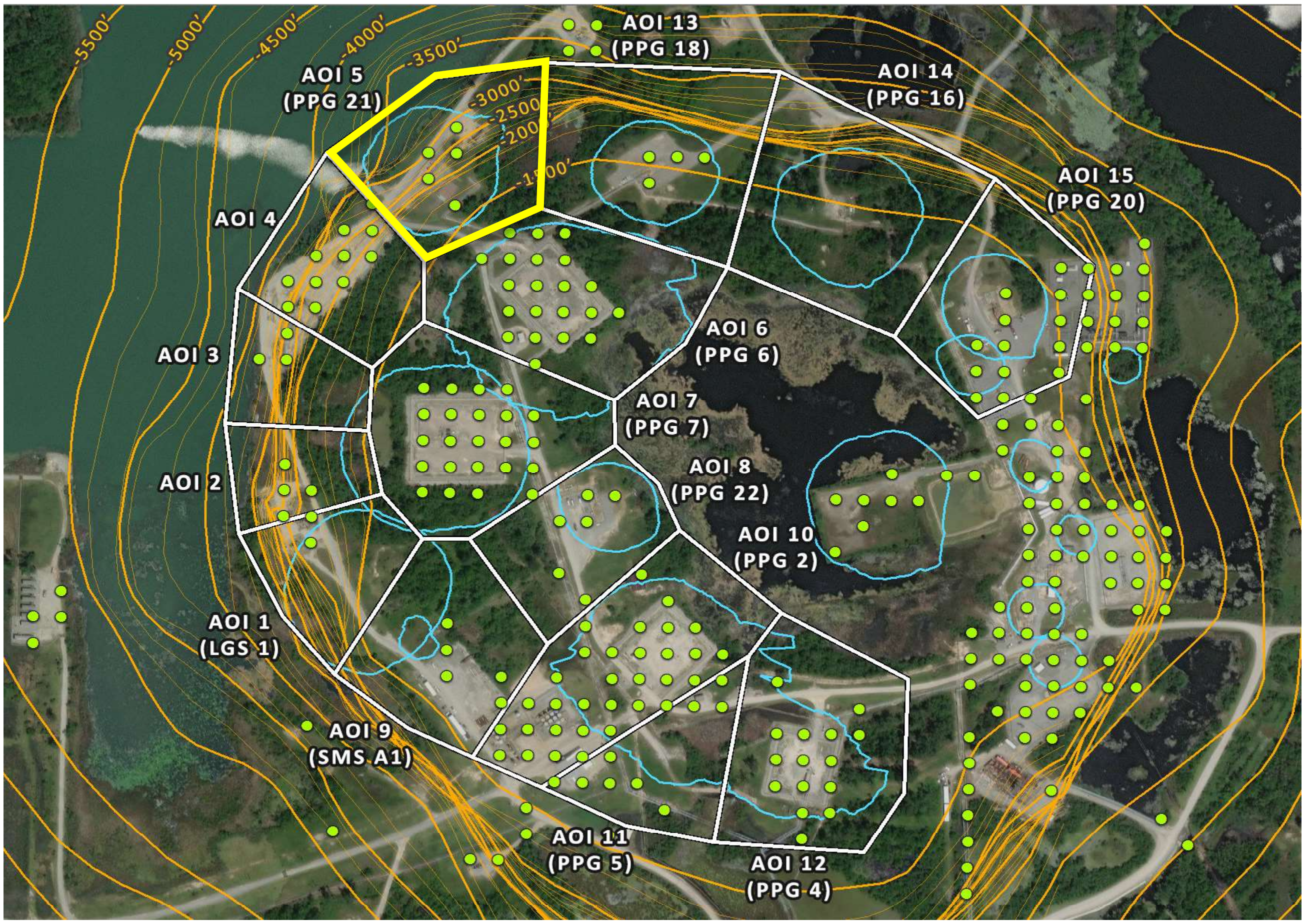
Vertical (7/27/2024) Point Count: **11**



	Nonlinear Trend		Linear Trend	
Velocity:	-0.28	in/yr	-0.53	in/yr
Acceleration:	+0.33	in/yr^2	0.00	in/yr^2

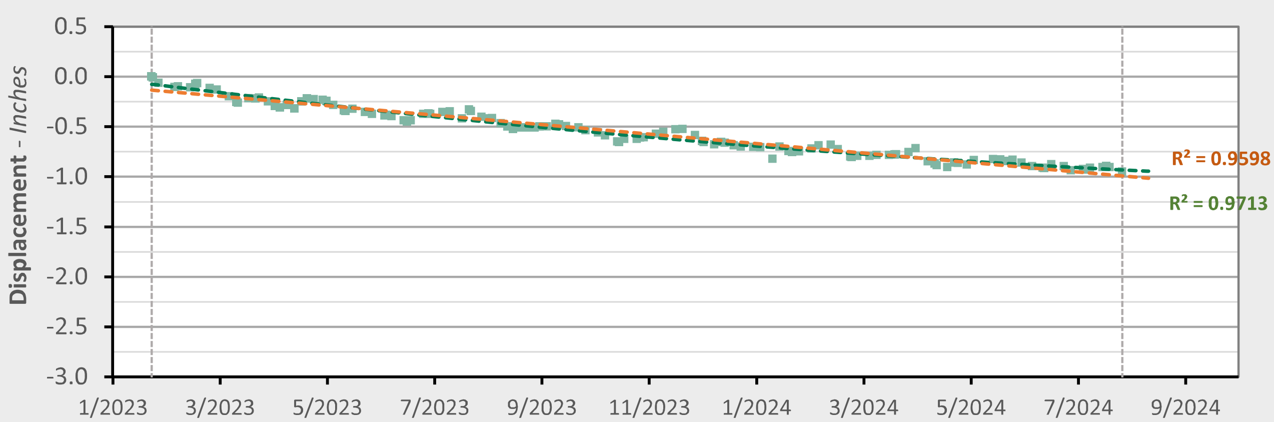
2D Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 5 *(PPG 21)* - Location Map



AOI 5 *(PPG 21)* - Vertical Time Series

Vertical (7/27/2024) Point Count: 5



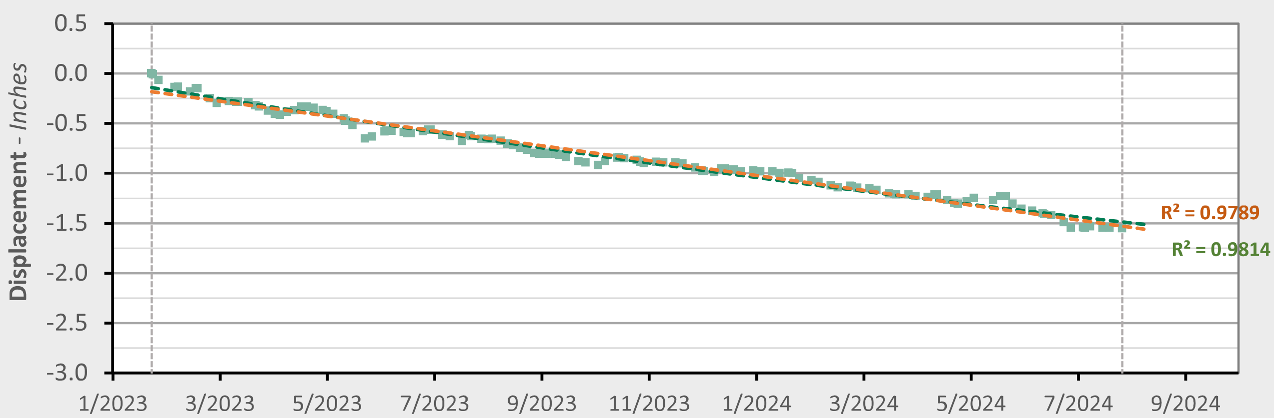
	Nonlinear Trend		Linear Trend	
Velocity:	-0.33	in/yr	-0.57	in/yr
Acceleration:	+0.32	in/yr^2	0.00	in/yr^2

2D Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 6 *(PPG 6)* - Location Map

AOI 6 *(PPG 6)* - Vertical Time Series

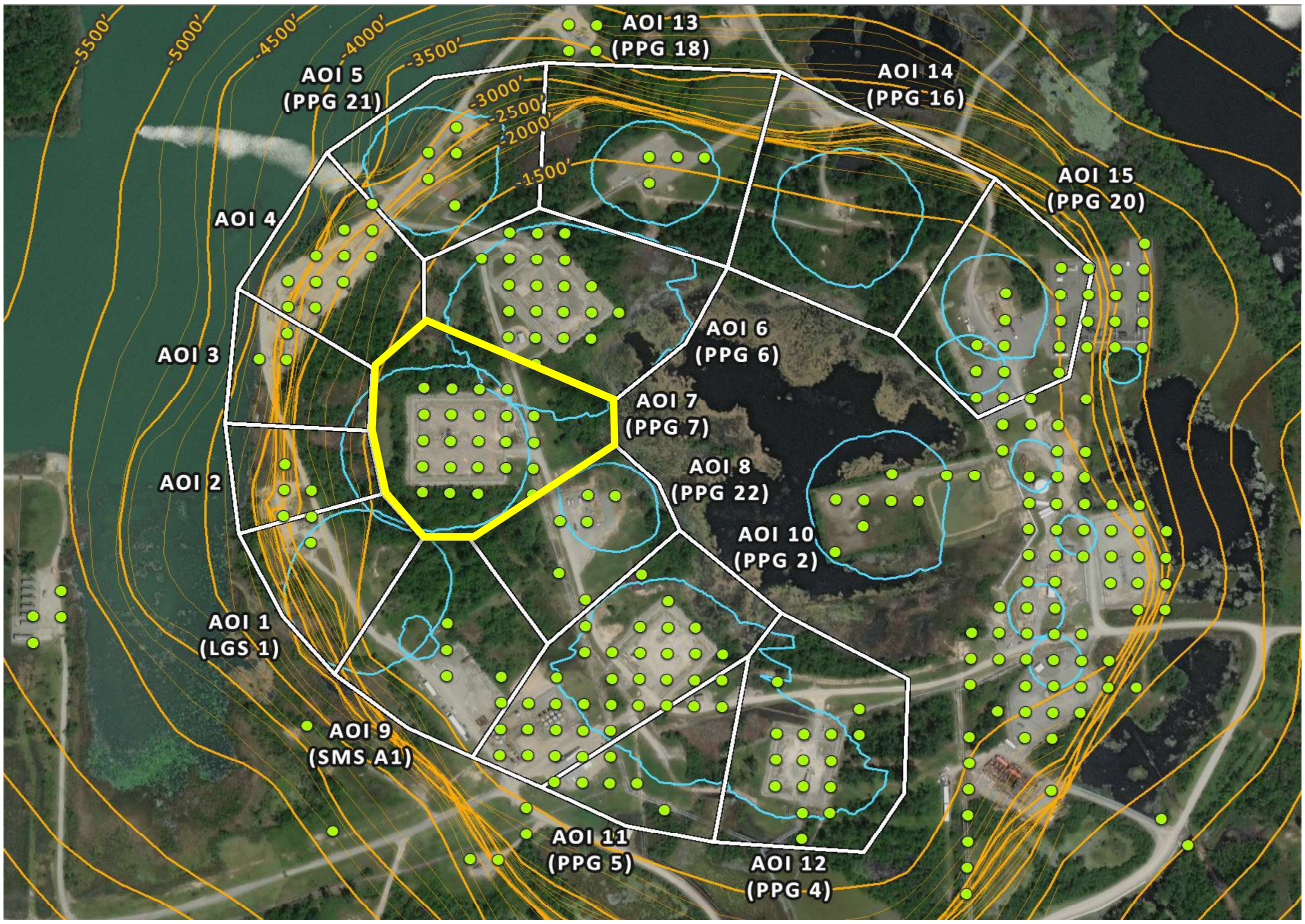
Vertical (7/27/2024) Point Count: **21**



	Nonlinear Trend	Linear Trend
Velocity:	-0.72 in/yr	-0.90 in/yr
Acceleration:	+0.23 in/yr^2	0.00 in/yr^2

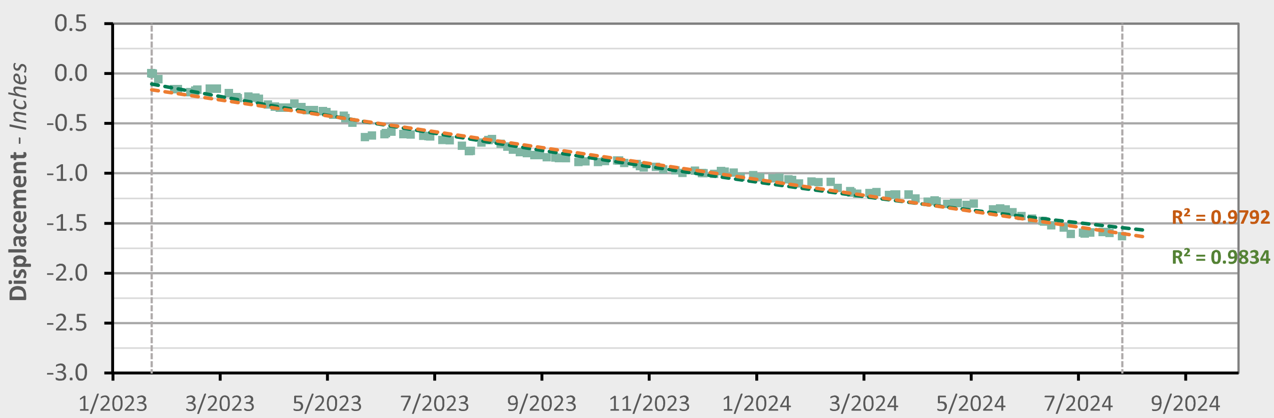
2D Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 7 *(PPG 7)* - Location Map



AOI 7 *(PPG 7)* - Vertical Time Series

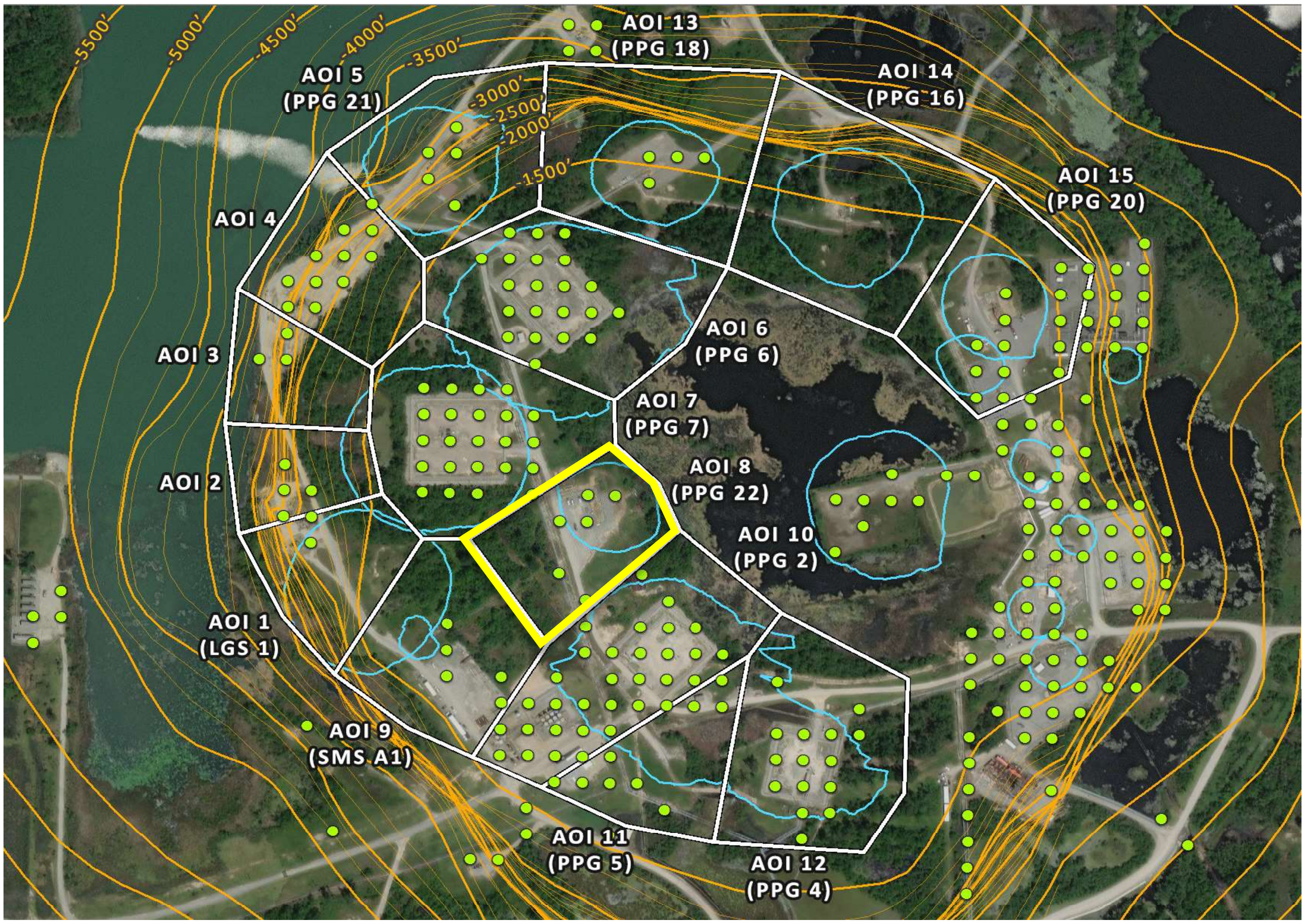
Vertical (7/27/2024) Point Count: 23



	Nonlinear Trend	Linear Trend
Velocity:	-0.72 in/yr	-0.96 in/yr
Acceleration:	+0.32 in/yr^2	0.00 in/yr^2

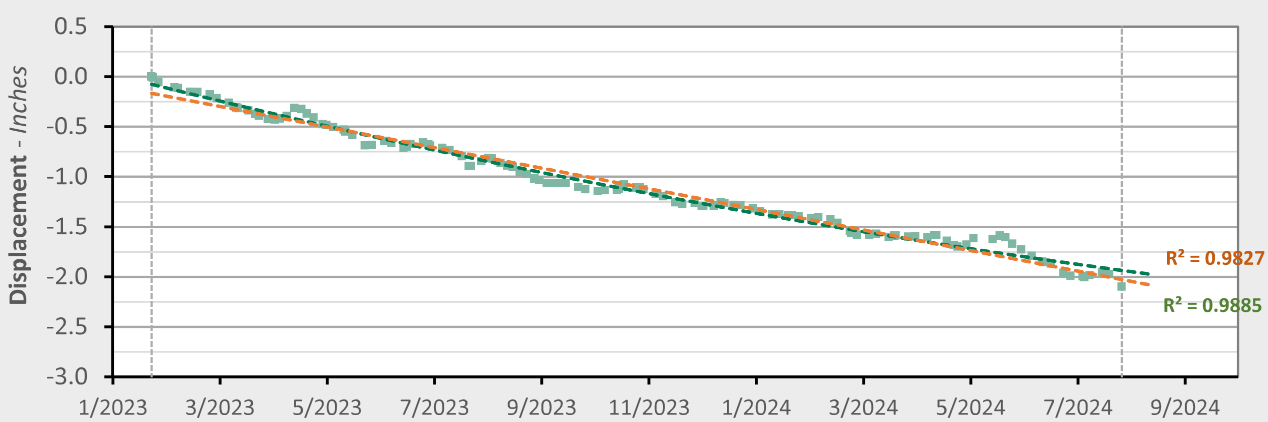
2D Displacement Measurement
Nonlinear Trend Line (Quadratic Regression)
Linear Trend Line (Linear Regression)

AOI 8 *(PPG 22)* - Location Map



AOI 8 *(PPG 22)* - Vertical Time Series

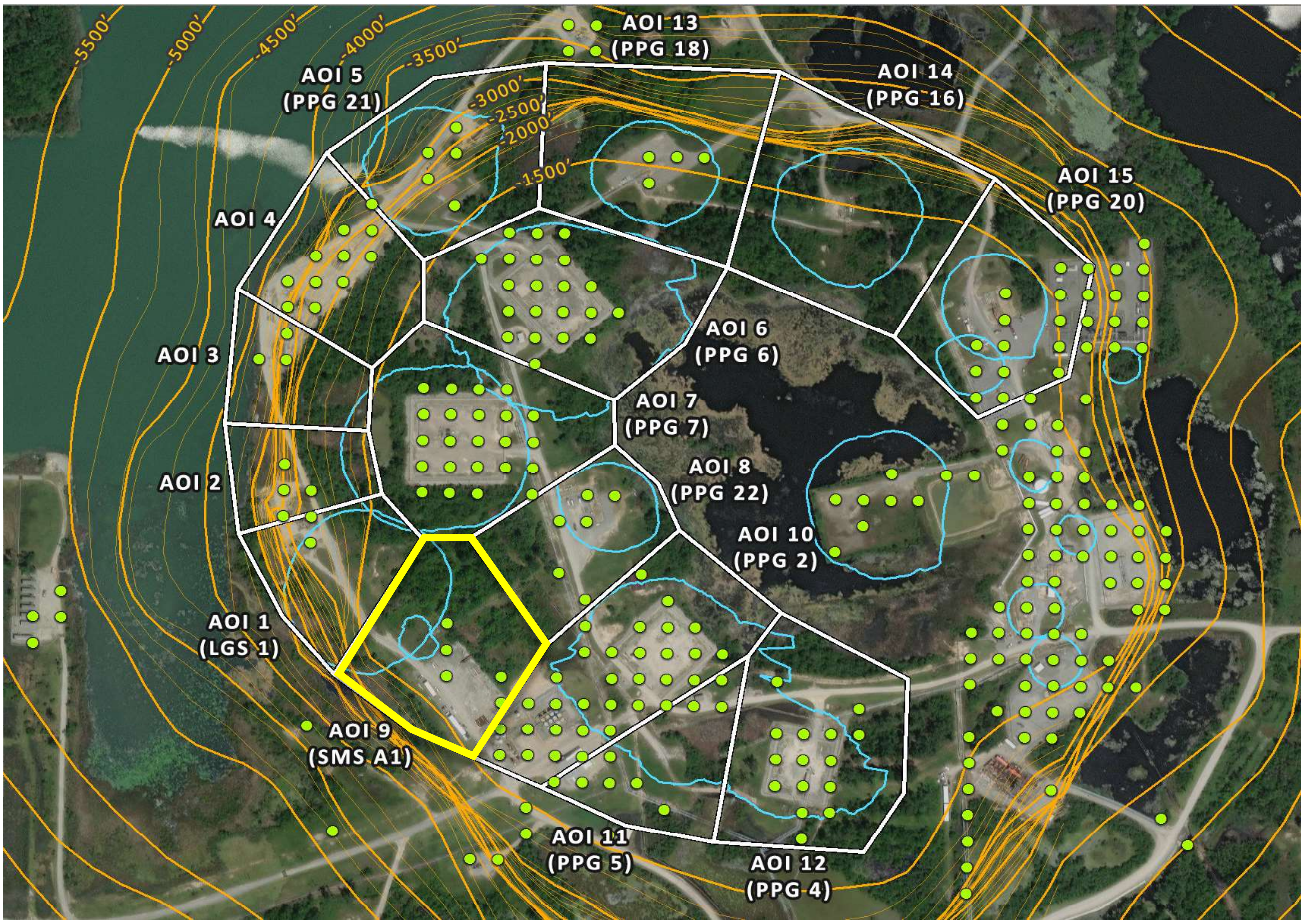
Vertical (7/27/2024) Point Count: **6**



	Nonlinear Trend		Linear Trend	
Velocity:	-0.87	in/yr	-1.24	in/yr
Acceleration:	+0.49	in/yr^2	0.00	in/yr^2

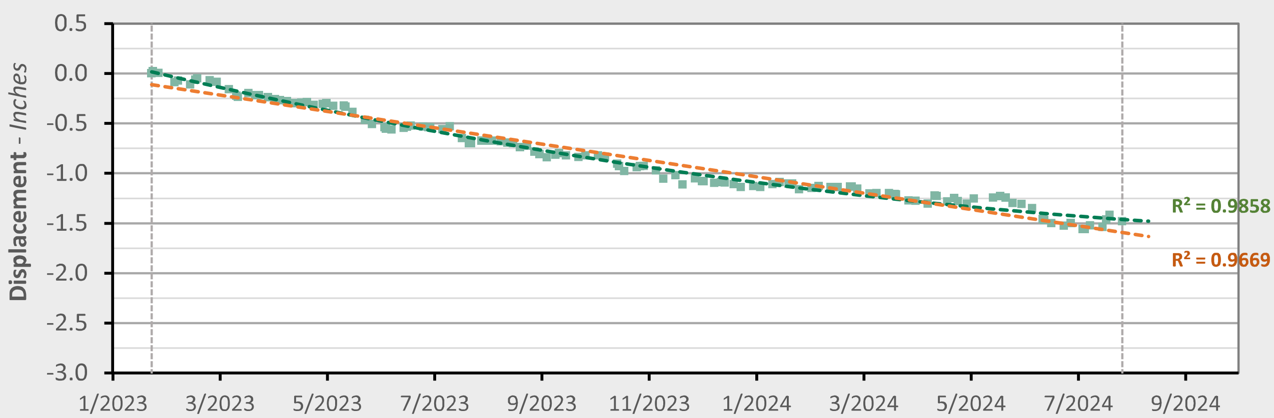
■ 2D Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 9 *(PPG A1)* - Location Map



AOI 9 *(SMS A1)* - Vertical Time Series

Vertical (7/27/2024) Point Count: 5



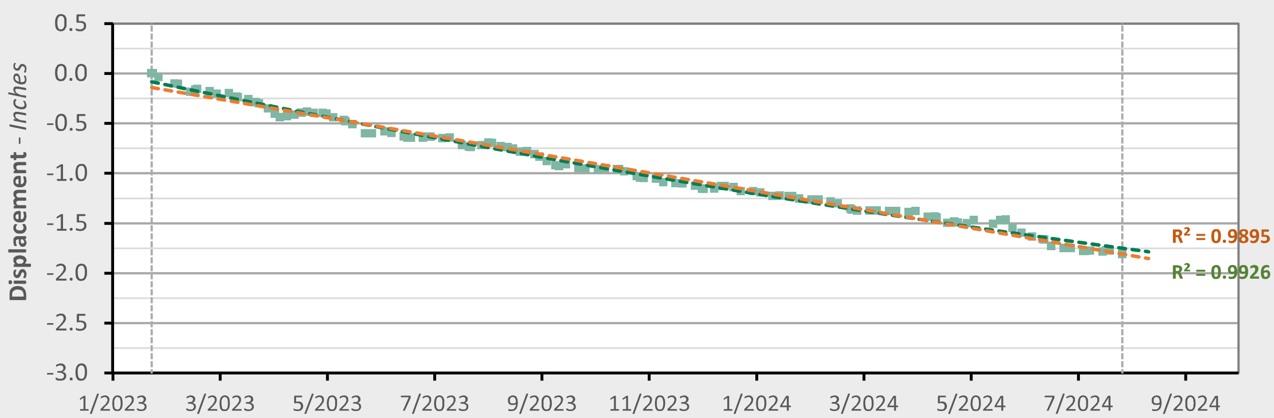
	Nonlinear Trend	Linear Trend
Velocity:	-0.45 in/yr	-0.98 in/yr
Acceleration:	+0.70 in/yr^2	0.00 in/yr^2

2D Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 10 *(PPG 2)* - Location Map

AOI 10 *(PPG 2)* - Vertical Time Series

Vertical (7/27/2024) Point Count: **32**



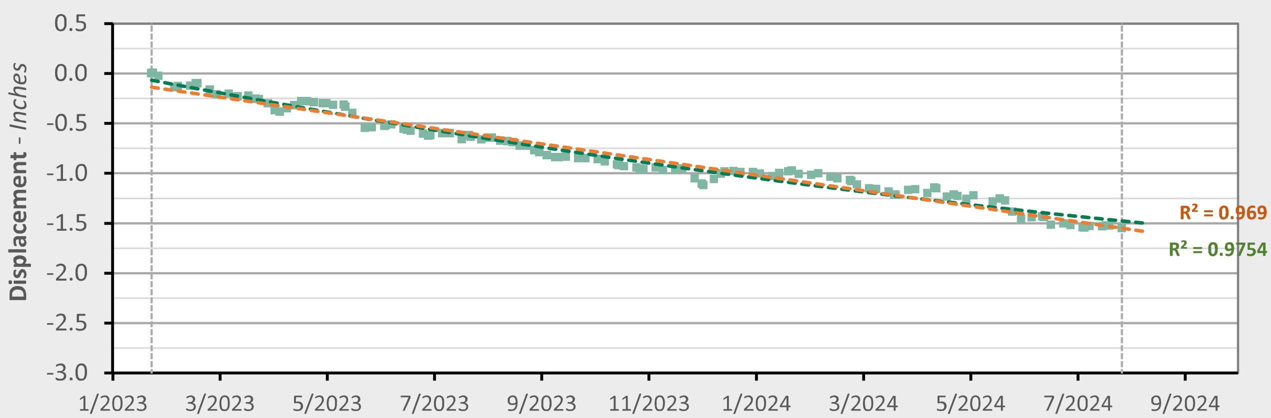
	Nonlinear Trend		Linear Trend	
Velocity:	-0.87	in/yr	-1.11	in/yr
Acceleration:	+0.31	in/yr^2	0.00	in/yr^2

2D Displacement Measurement | Nonlinear Trend Line (Quadratic Regression) | Linear Trend Line (Linear Regression)

AOI 11 *(PPG 5)* - Location Map

AOI 11 *(PPG 5)* - Vertical Time Series

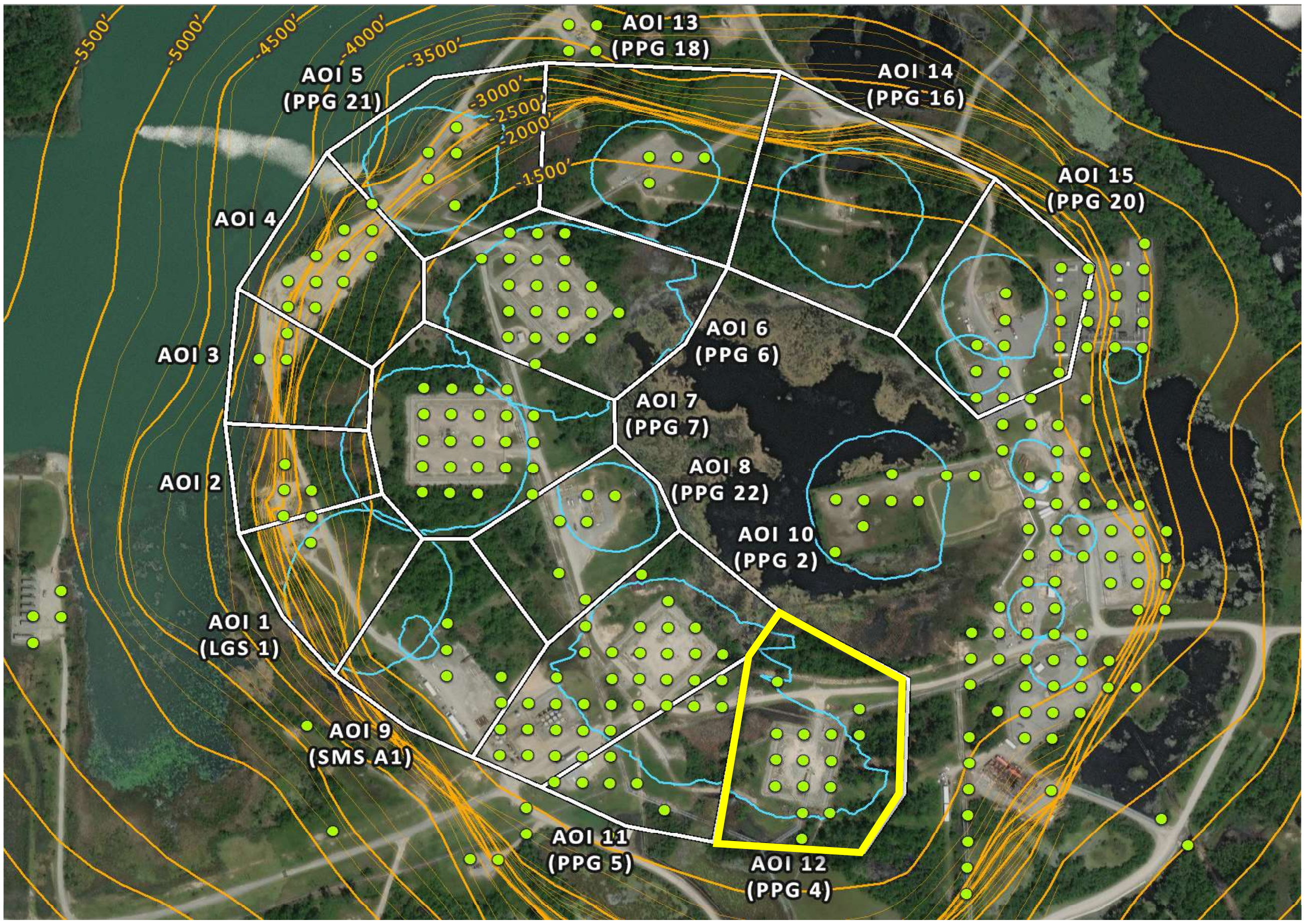
Vertical (7/27/2024) Point Count: **9**



	Nonlinear Trend		Linear Trend	
Velocity:	-0.64	in/yr	-0.94	in/yr
Acceleration:	+0.39	in/yr^2	0.00	in/yr^2

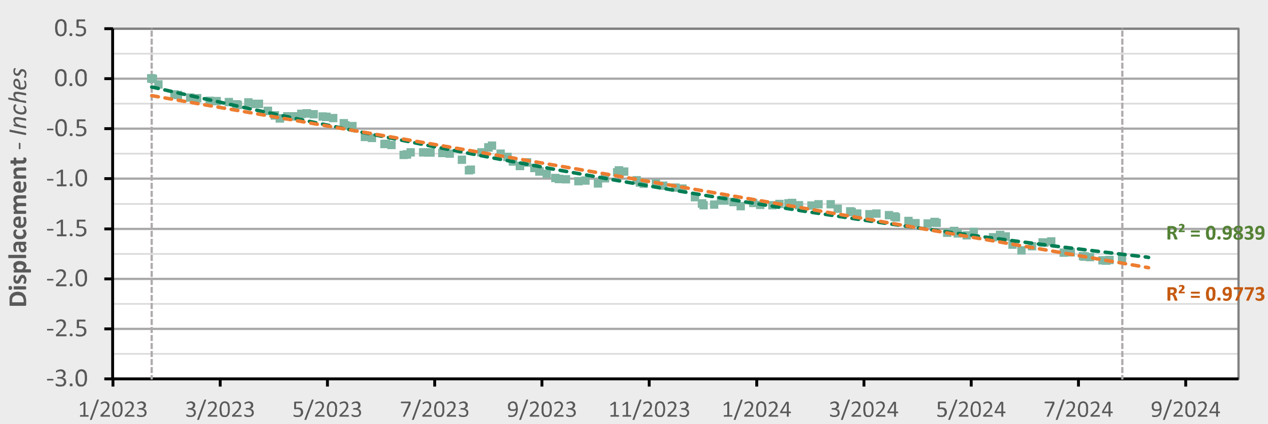
2D Displacement Measurement   Nonlinear Trend Line (Quadratic Regression)   Linear Trend Line (Linear Regression)

AOI 12 *(PPG 4)* - Location Map



AOI 12 *(PPG 4)* - Vertical Time Series

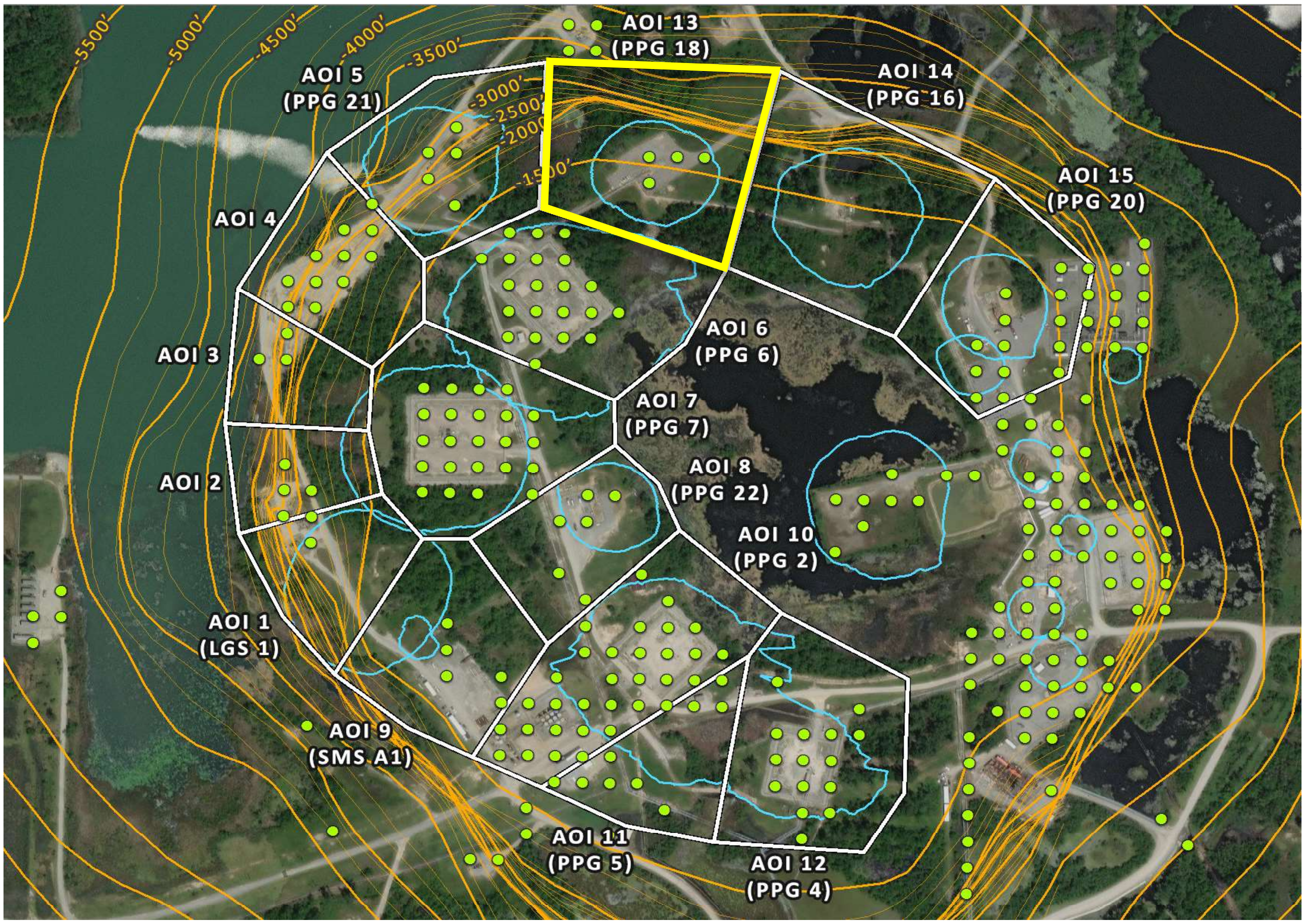
Vertical (7/27/2024) Point Count: **15**



	Nonlinear Trend	Linear Trend
Velocity:	-0.76 in/yr	-1.11 in/yr
Acceleration:	+0.47 in/yr^2	0.00 in/yr^2

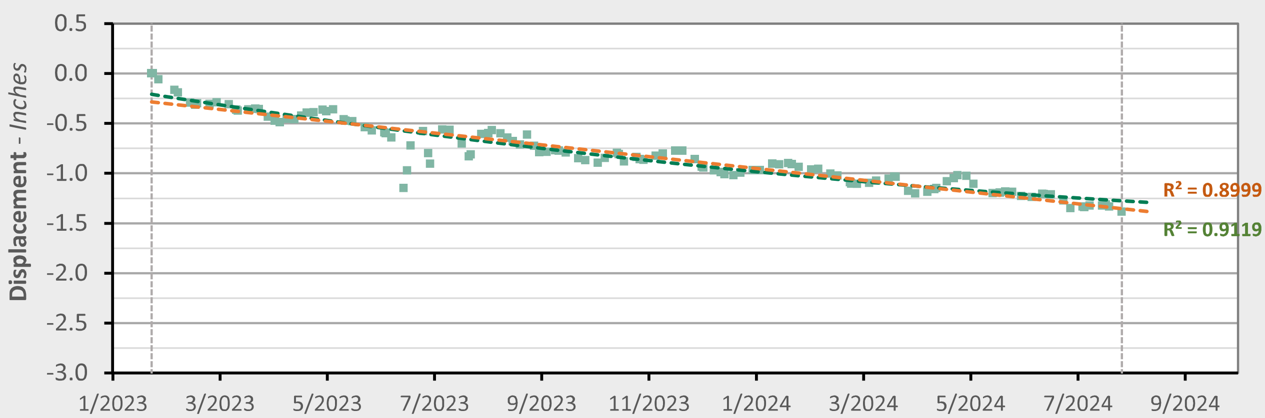
2D Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 13 *(PPG 18)* - Location Map



AOI 13 *(PPG 18)* - Vertical Time Series

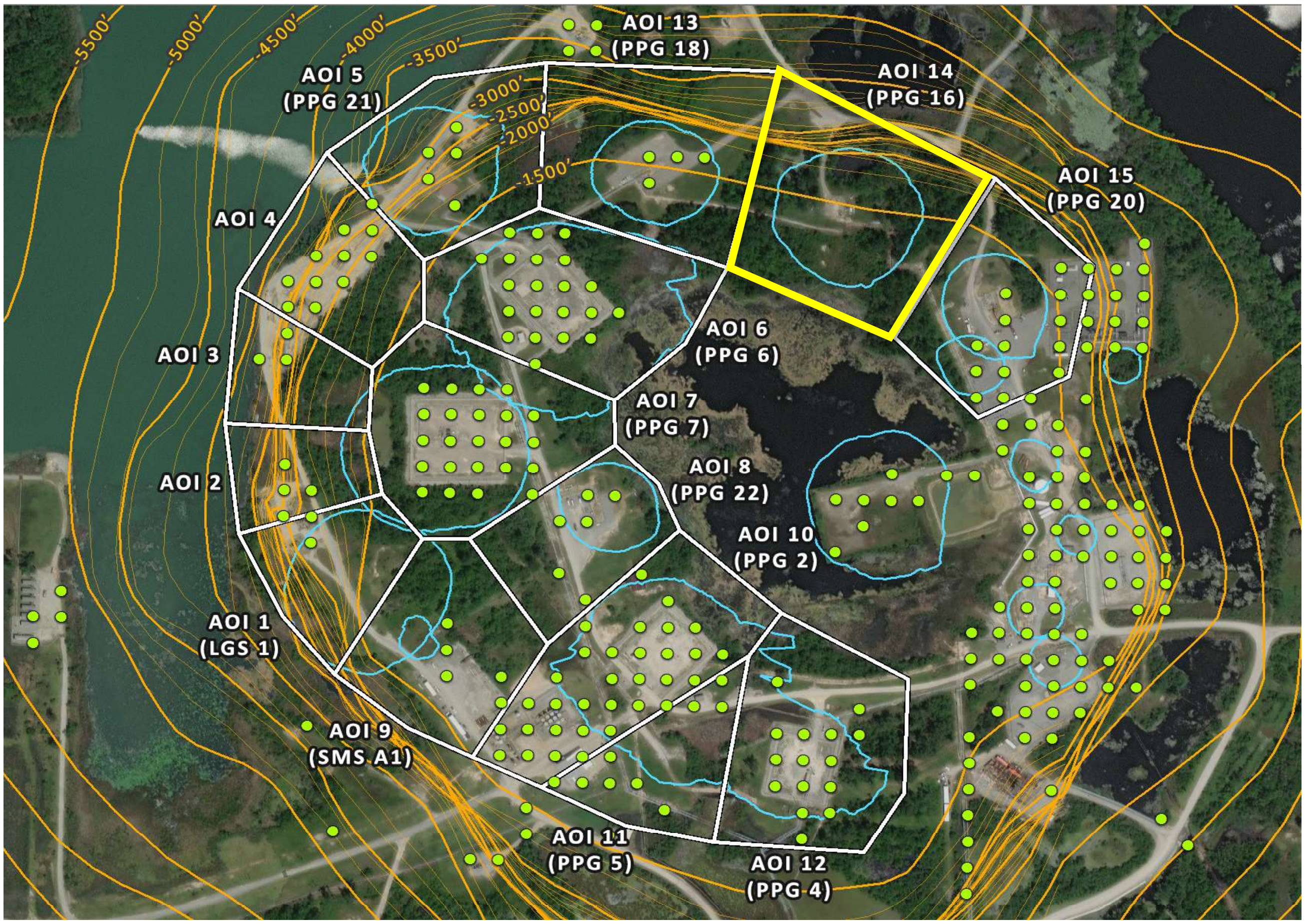
Vertical (7/27/2024) Point Count: **4**



	Nonlinear Trend		Linear Trend	
Velocity:	-0.39	in/yr	-0.71	in/yr
Acceleration:	+0.42	in/yr^2	0.00	in/yr^2

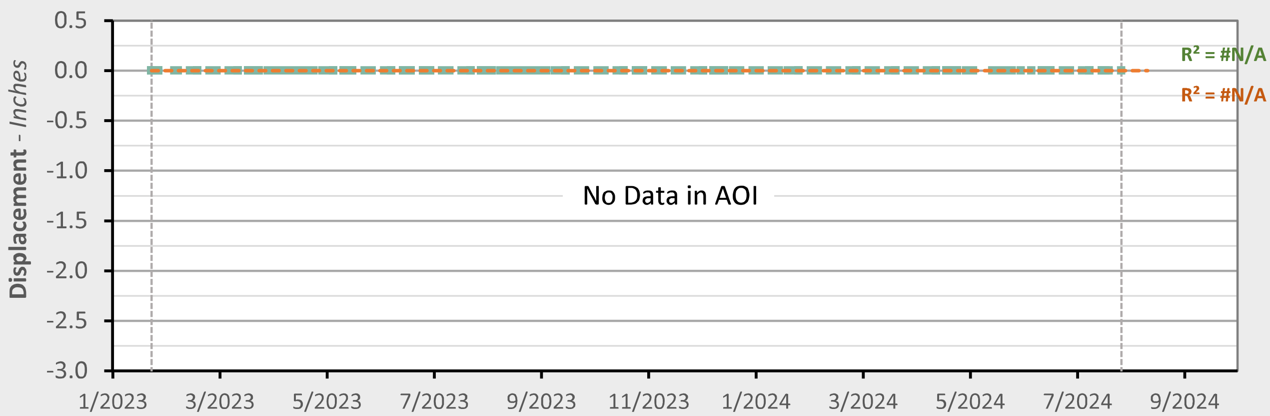
2D Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 14 *(PPG 16)* - Location Map



AOI 14 *(PPG 16)* - Vertical Time Series

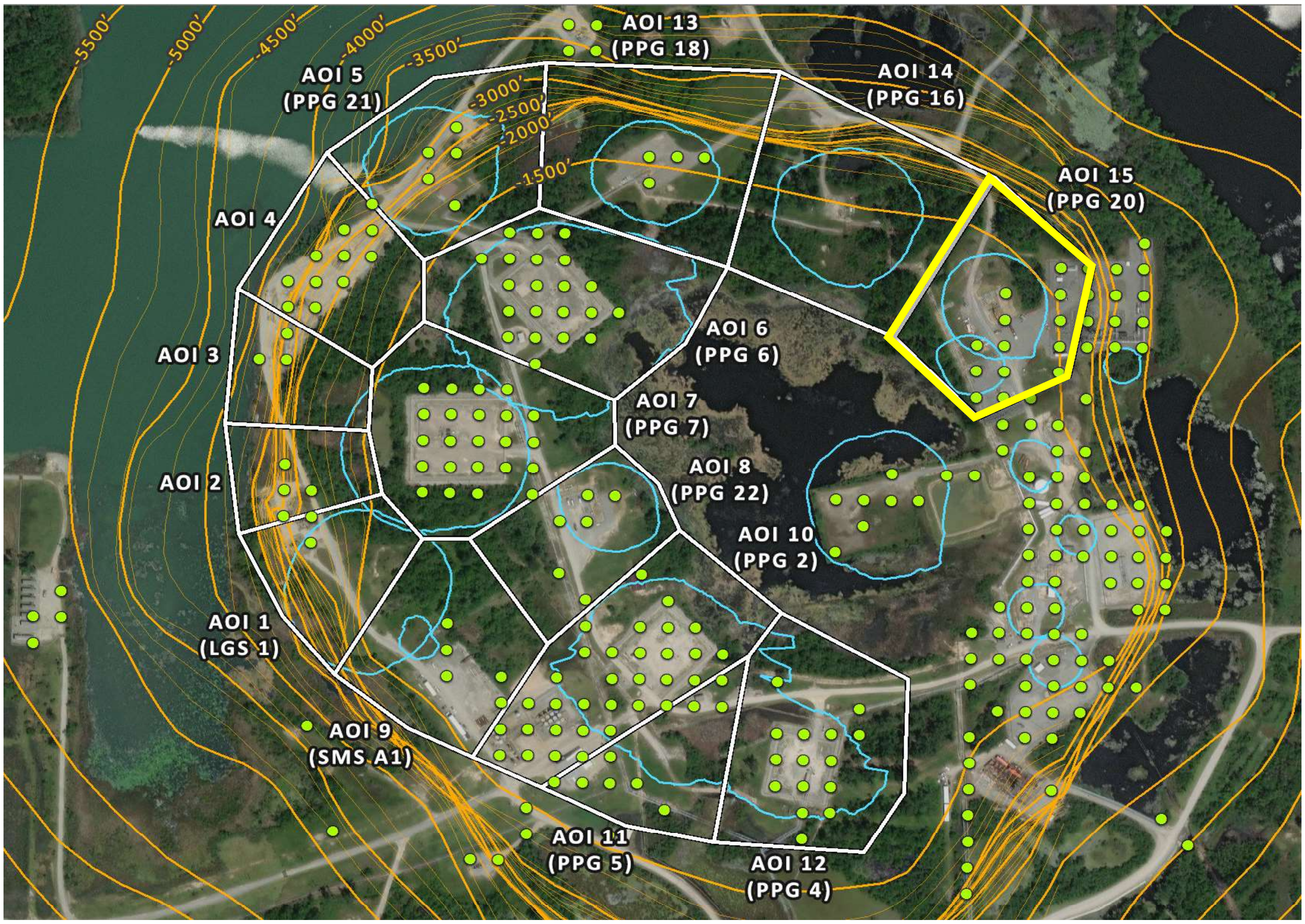
Vertical (7/27/2024) Point Count: **0**



	Nonlinear Trend		Linear Trend	
Velocity:	N/A	in/yr	N/A	in/yr
Acceleration:	N/A	in/yr^2	N/A	in/yr^2

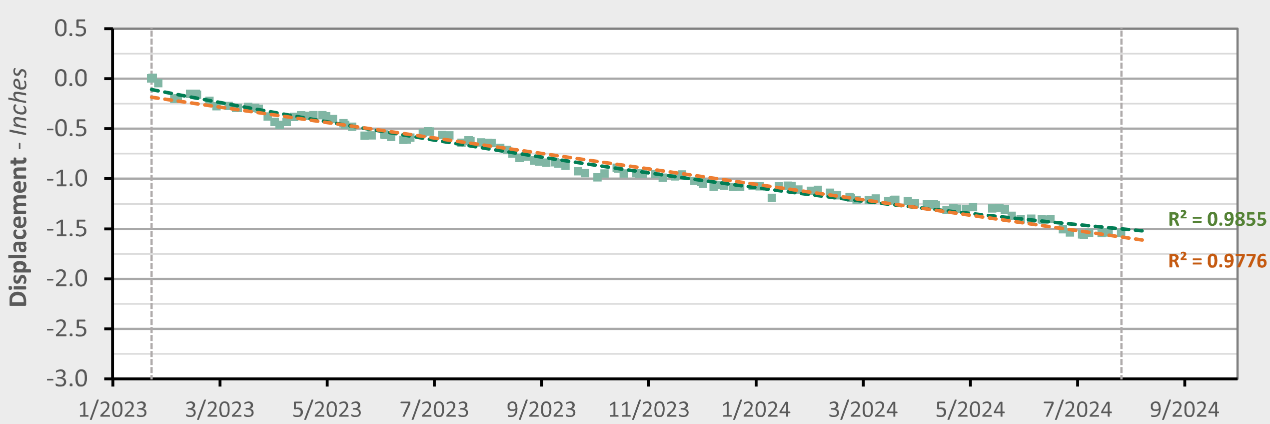
2D Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 15 *(PPG 20)* - Location Map



AOI 15 *(PPG 20)* - Vertical Time Series

Vertical (7/27/2024) Point Count: **14**



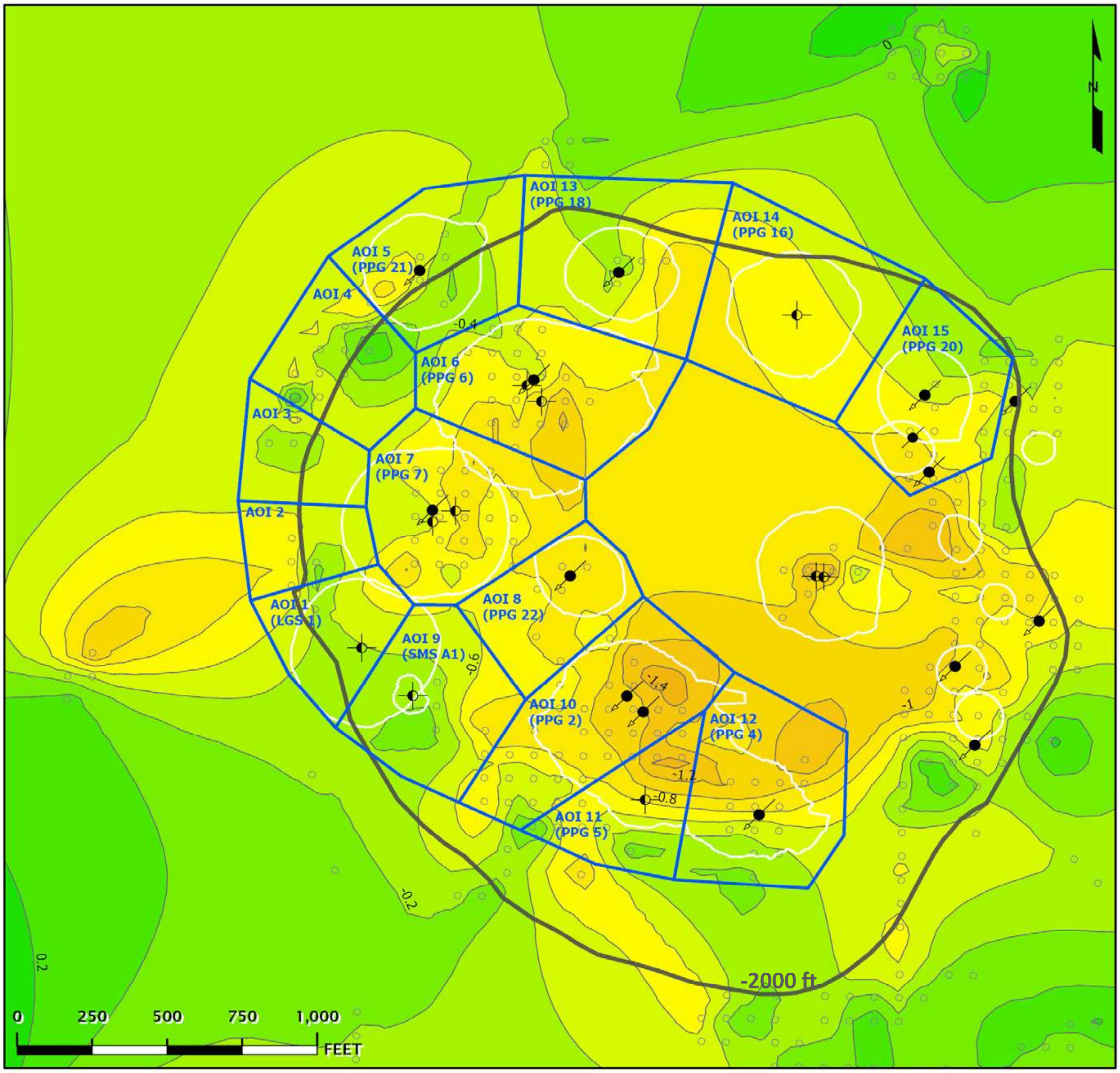
	Nonlinear Trend	Linear Trend
Velocity:	-0.60 in/yr	-0.93 in/yr
Acceleration:	+0.43 in/yr^2	0.00 in/yr^2

2D Displacement Measurement
Nonlinear Trend Line (Quadratic Regression)
Linear Trend Line (Linear Regression)

Vertical Data (01/24/2023 - 07/27/2024)

Nonlinear Velocity Contours

As of date: 07/27/2024



-3.0 -2.0 -1.0 0.0 +1.0 +2.0 +3.0

Inches/year

AOI Boundary
InSAR LOS Measurement Point
Contour (0.2)
Historical Cavern Extent
Top of Dome (-2000 ft Contour)

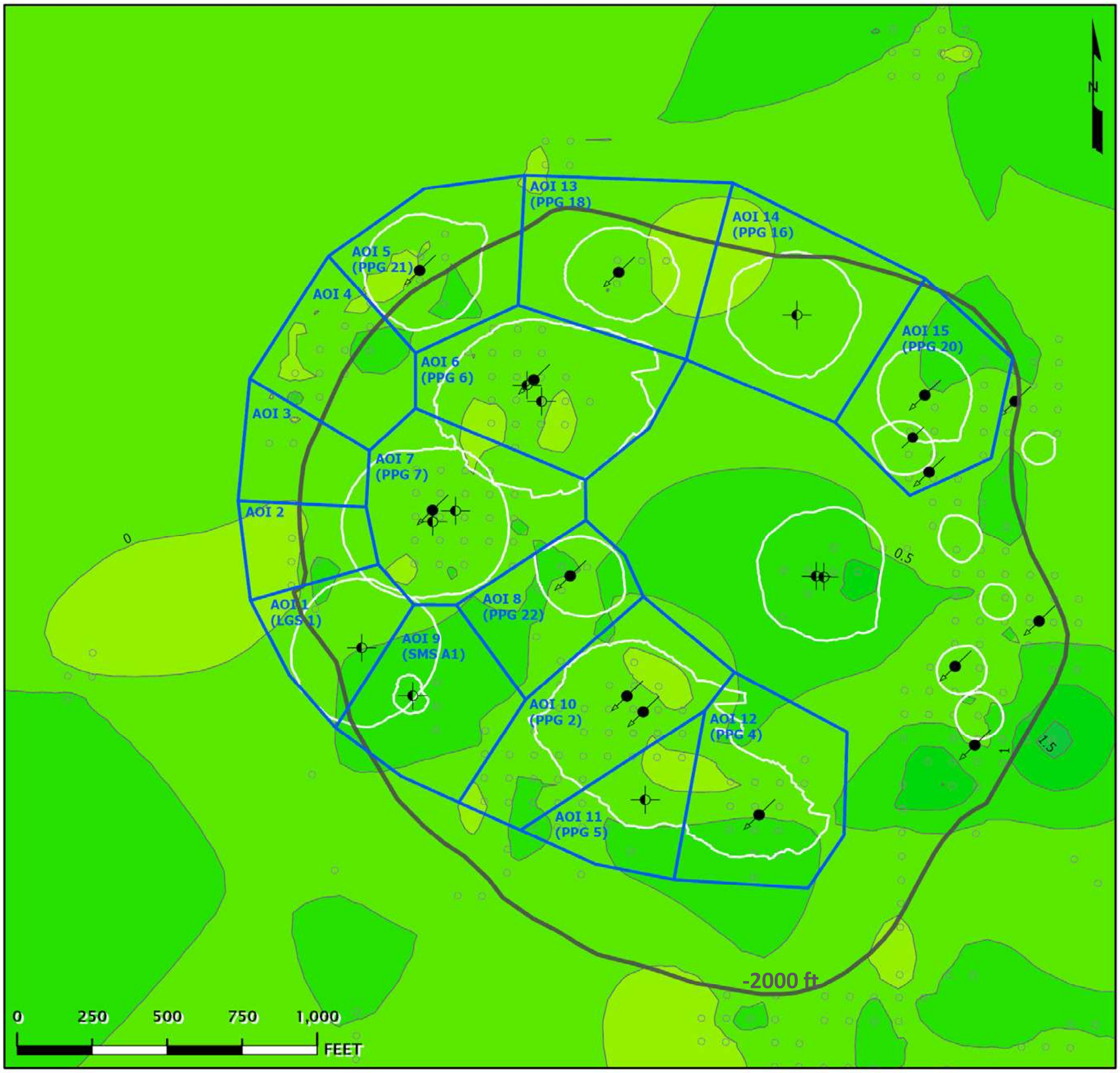
Cavern Well Surface Locations

09 - Active - Injection
29 - Dry and Plugged

Vertical Data (01/24/2023 - 07/27/2024)

Nonlinear Acceleration Contours

Date range: 01/24/2023 - 07/27/2024



AOI Boundary | InSAR LOS Measurement Point | Contour (0.5)

Historical Cavern Extent | Top of Dome (-2000 ft Contour)

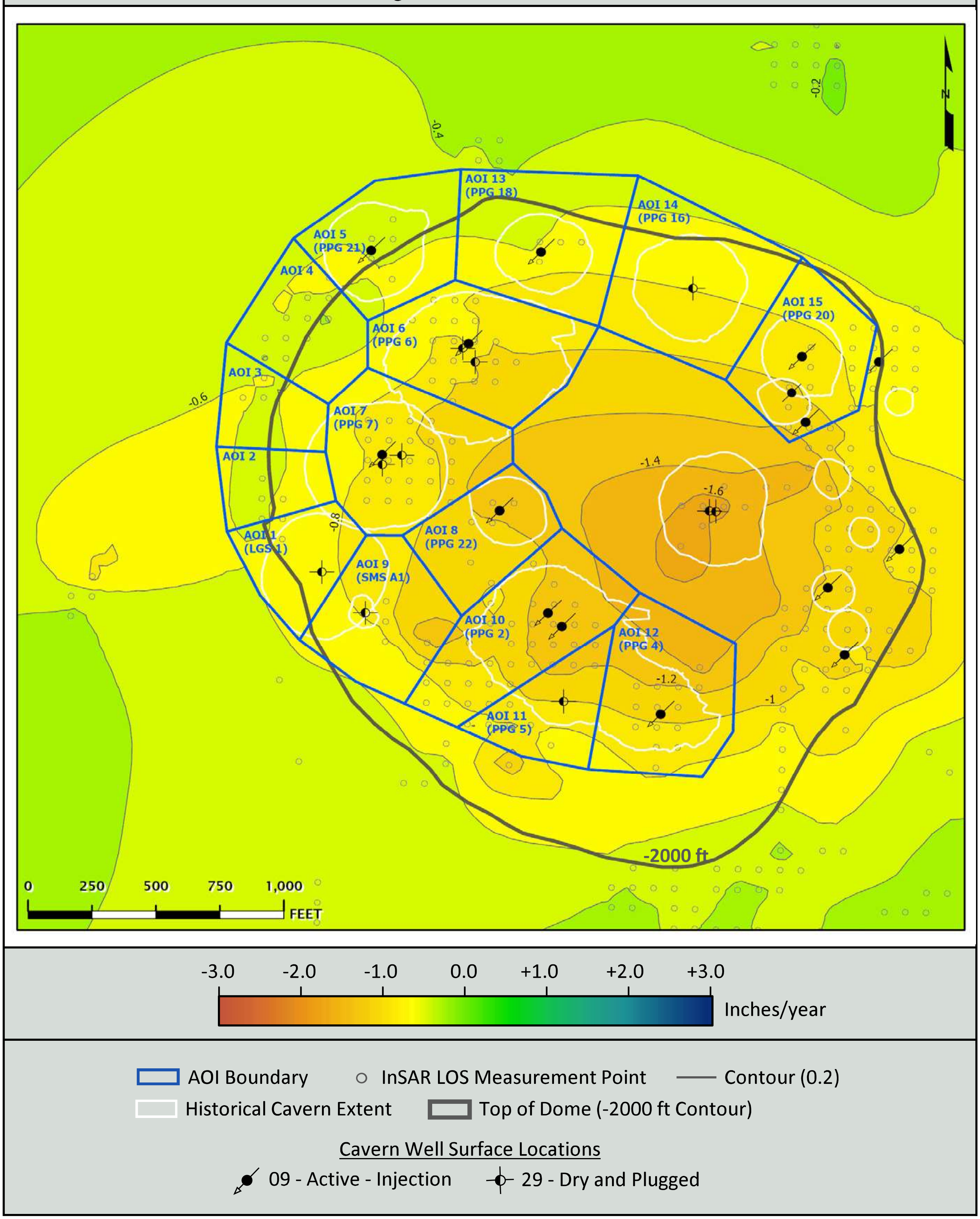
Cavern Well Surface Locations

09 - Active - Injection | 29 - Dry and Plugged

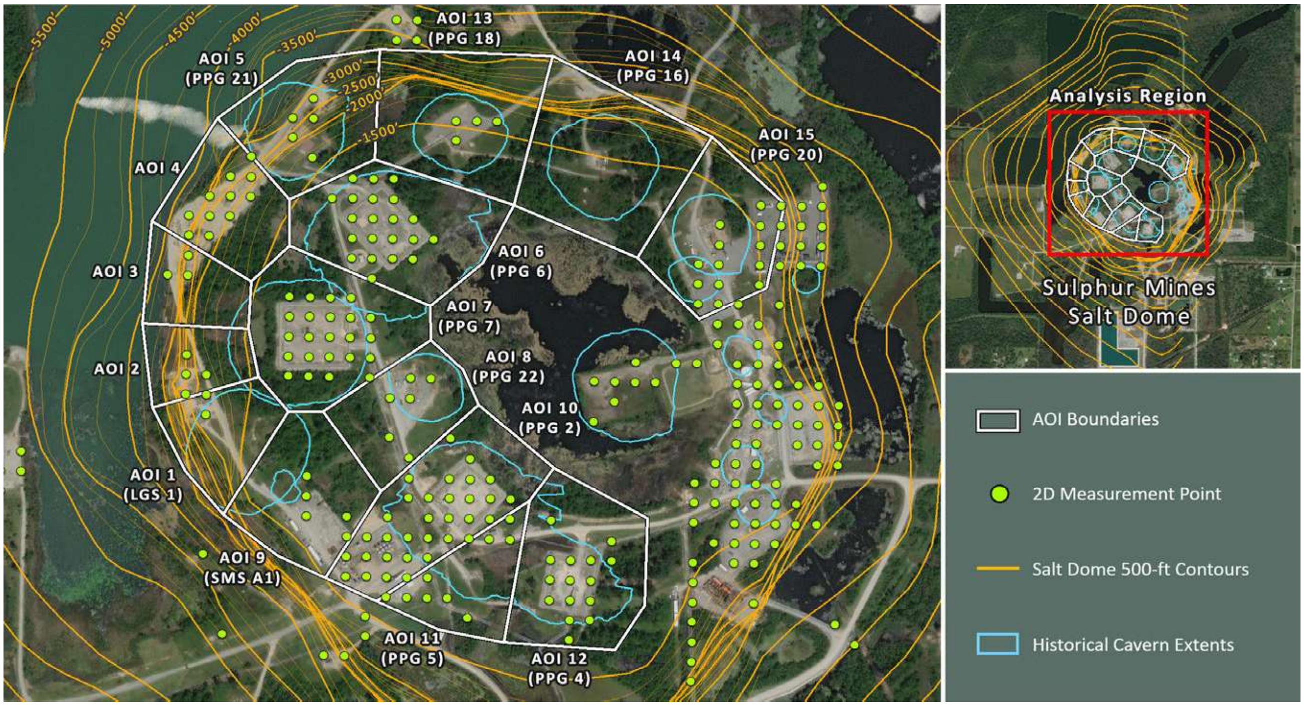
Vertical Data (01/24/2023 - 07/27/2024)

Linear Velocity Contours

Date range: 01/24/2023 - 07/27/2024



AOI Boundaries & 2D InSAR Measurement Points

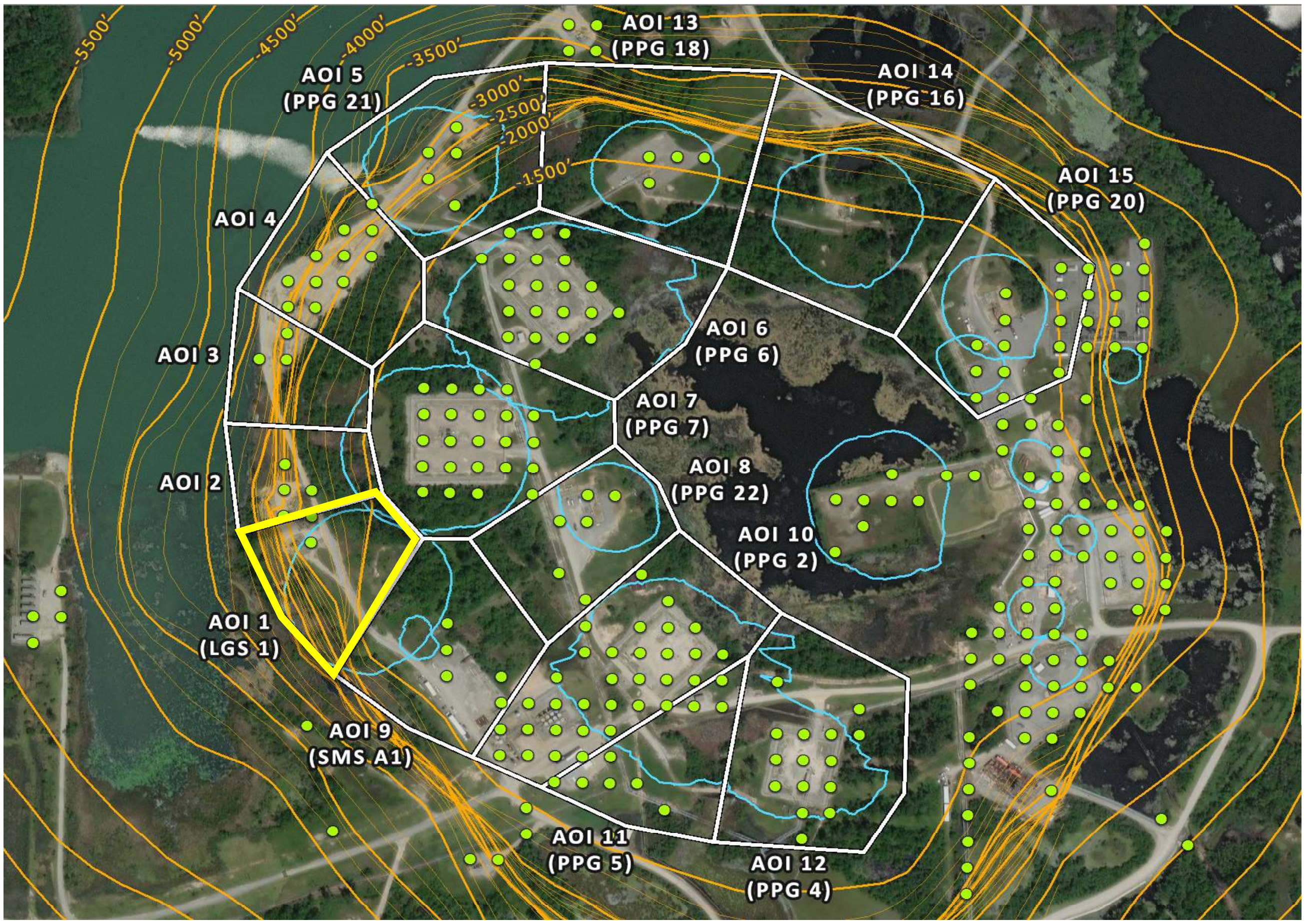


Subsidence Monitoring Areas of Interest (AOIs)

To visually convey and evaluate trend consistency for the East-West displacement time series of each ground target, measurment points were grouped and their displacement values were averaged. The point groups are referred to as Areas of Interest (AOIs) in this analysis and their boundaries are depicted on the above map. The below table lists the East-West trend values calculated in each AOI for the dataset evaluated in this report.

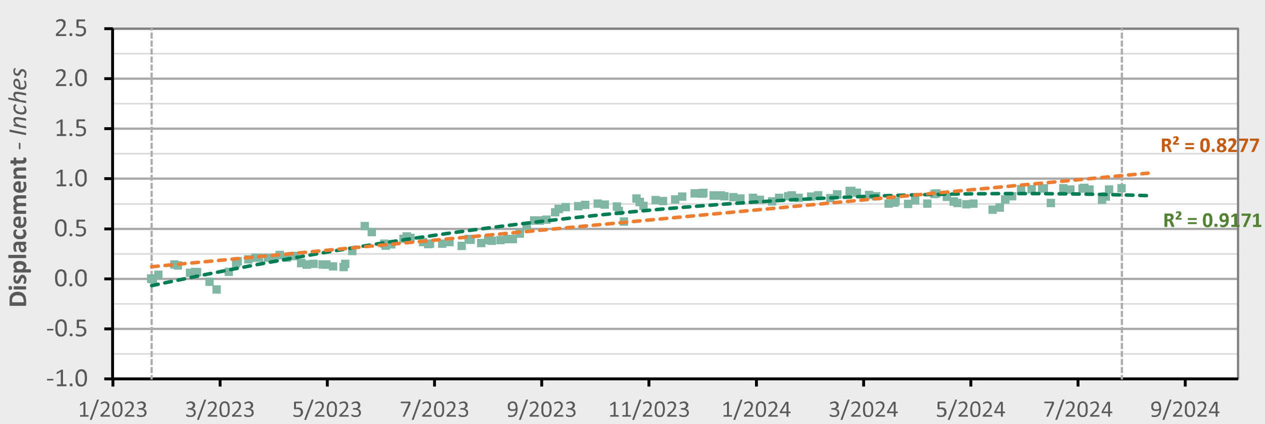
AOI Name	East-West (7/27/2024)	East-West Velocity (in/yr)		East-West Acceleration (in/yr²)	
	Point Count	Nonlinear	Linear	Nonlinear	Linear
AOI 1 *(LGS 1)*	2	-0.16	+0.61	-1.02	0.00
AOI 2	4	+0.15	+0.64	-0.65	0.00
AOI 3	3	-0.09	+0.55	-0.85	0.00
AOI 4	11	+0.19	+0.48	-0.39	0.00
AOI 5 *(PPG 21)*	5	+0.13	+0.22	-0.12	0.00
AOI 6 *(PPG 6)*	21	+0.13	+0.34	-0.28	0.00
AOI 7 *(PPG 7)*	23	+0.19	+0.58	-0.52	0.00
AOI 8 *(PPG 22)*	6	+0.13	+0.53	-0.53	0.00
AOI 9 *(SMS A1)*	5	+0.06	+0.44	-0.50	0.00
AOI 10 *(PPG 2)*	32	+0.13	+0.34	-0.27	0.00
AOI 11 *(PPG 5)*	9	+0.17	+0.35	-0.23	0.00
AOI 12 *(PPG 4)*	15	-0.54	-0.17	-0.49	0.00
AOI 13 *(PPG 18)*	4	-0.64	-0.03	-0.81	0.00
AOI 14 *(PPG 16)*	0	N/A	N/A	N/A	N/A
AOI 15 *(PPG 20)*	14	-0.68	-0.55	-0.18	0.00

AOI 1 *(LGS 1)* - Location Map



AOI 1 *(LGS 1)* - East-West Time Series

E-W (7/27/2024) Point Count: **2**



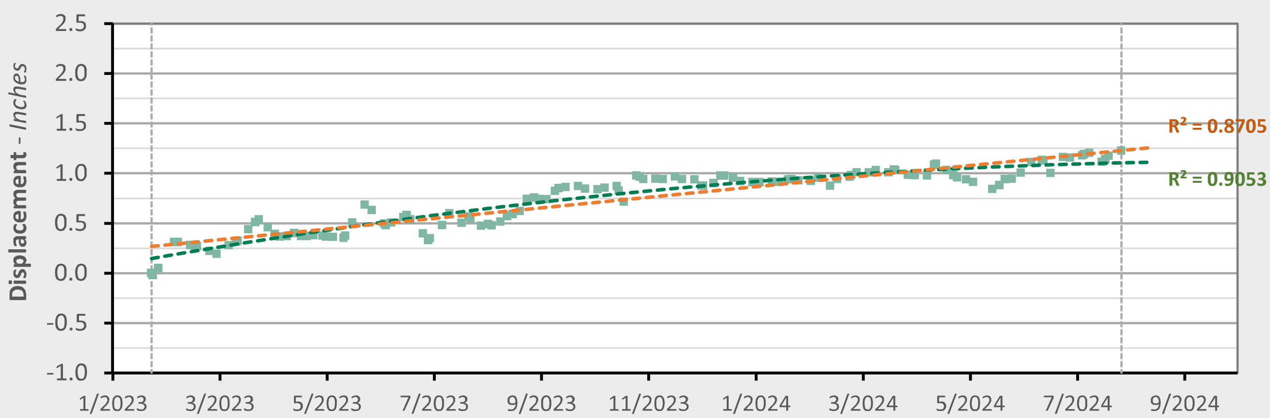
	Nonlinear Trend	Linear Trend
Velocity:	-0.16 in/yr	+0.61 in/yr
Acceleration:	-1.02 in/yr^2	0.00 in/yr^2

2D Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 2 - Location Map

AOI 2 - East-West Time Series

E-W (7/27/2024) Point Count: 4



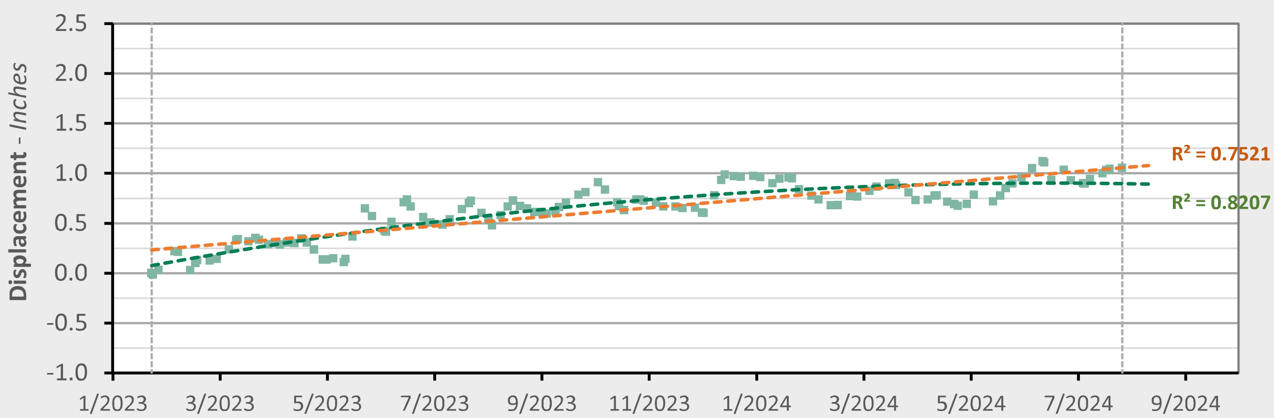
	Nonlinear Trend	Linear Trend
Velocity:	+0.15 in/yr	+0.64 in/yr
Acceleration:	-0.65 in/yr^2	0.00 in/yr^2

2D Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 3 - Location Map

AOI 3 - East-West Time Series

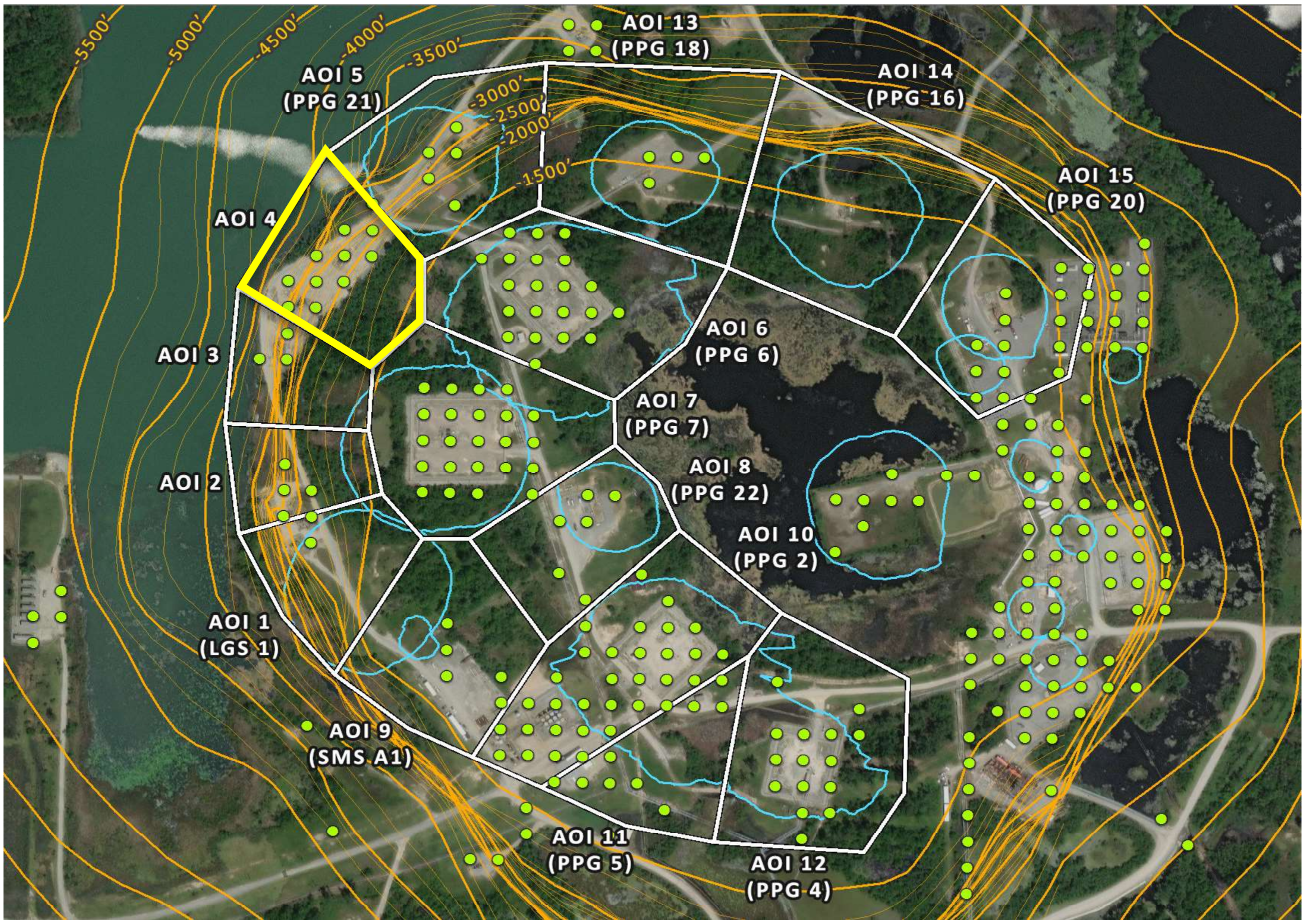
E-W (7/27/2024) Point Count: 3



	Nonlinear Trend	Linear Trend
Velocity:	-0.09 in/yr	+0.55 in/yr
Acceleration:	-0.85 in/yr^2	0.00 in/yr^2

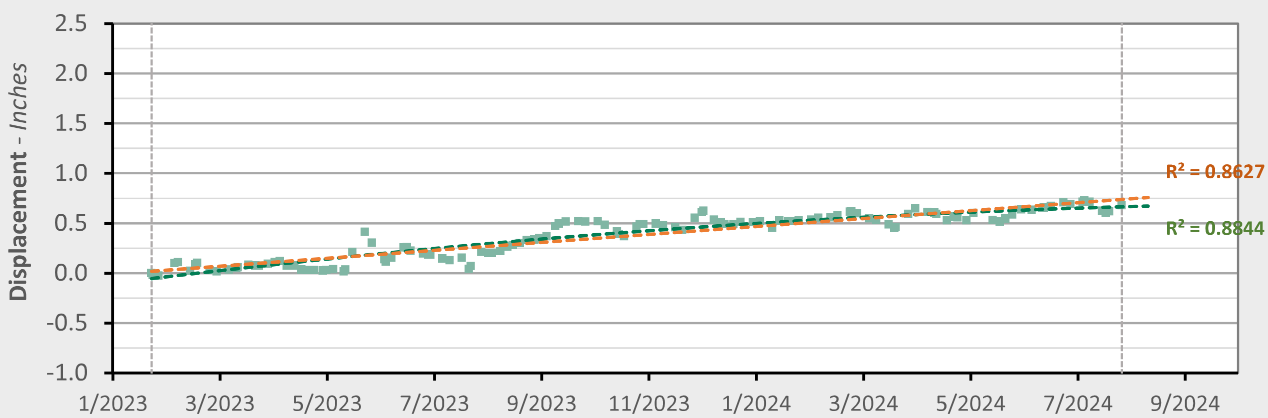
2D Displacement Measurement | Nonlinear Trend Line (Quadratic Regression) | Linear Trend Line (Linear Regression)

AOI 4 - Location Map



AOI 4 - East-West Time Series

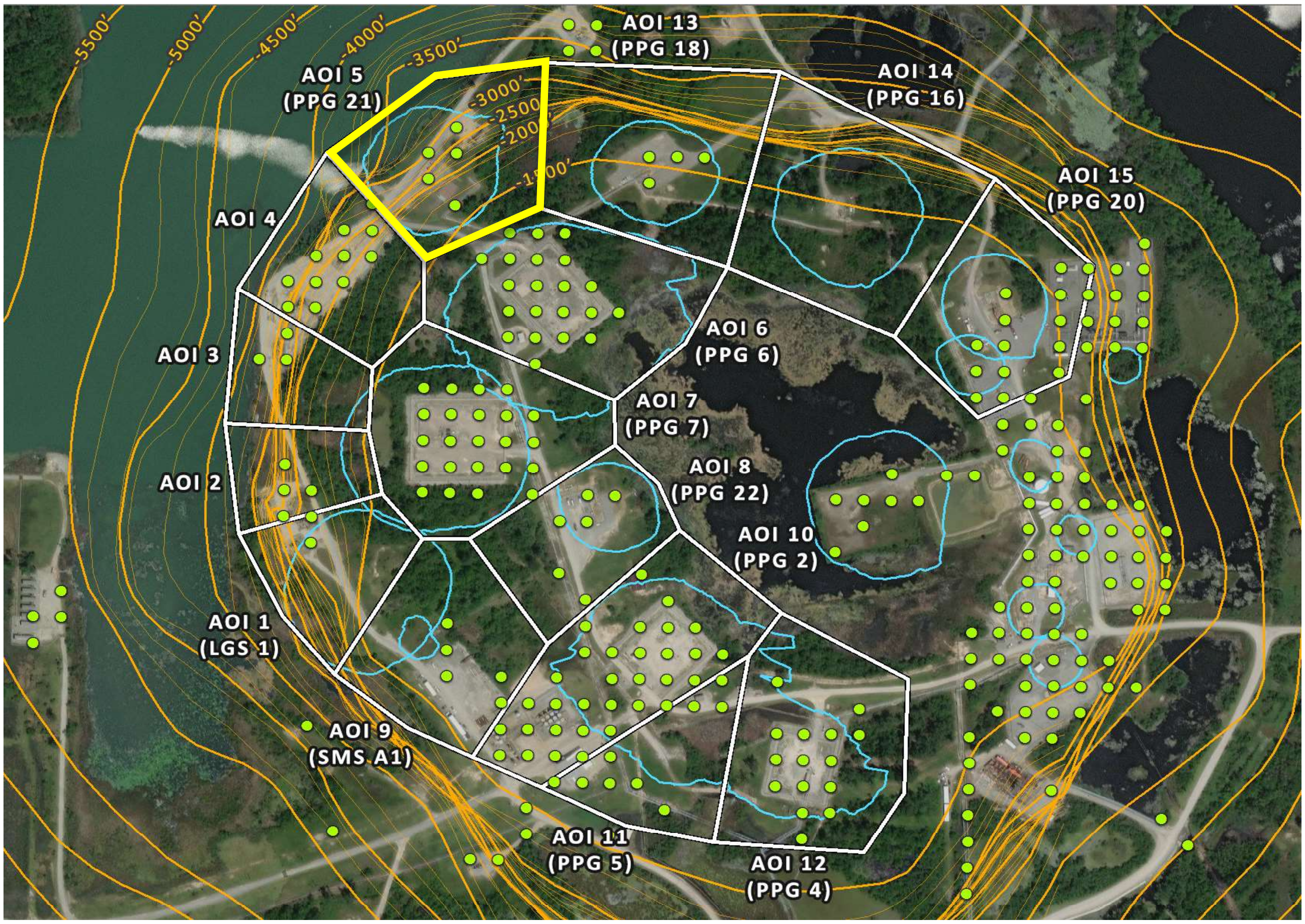
E-W (7/27/2024) Point Count: 11



	Nonlinear Trend	Linear Trend
Velocity:	+0.19 in/yr	+0.48 in/yr
Acceleration:	-0.39 in/yr^2	0.00 in/yr^2

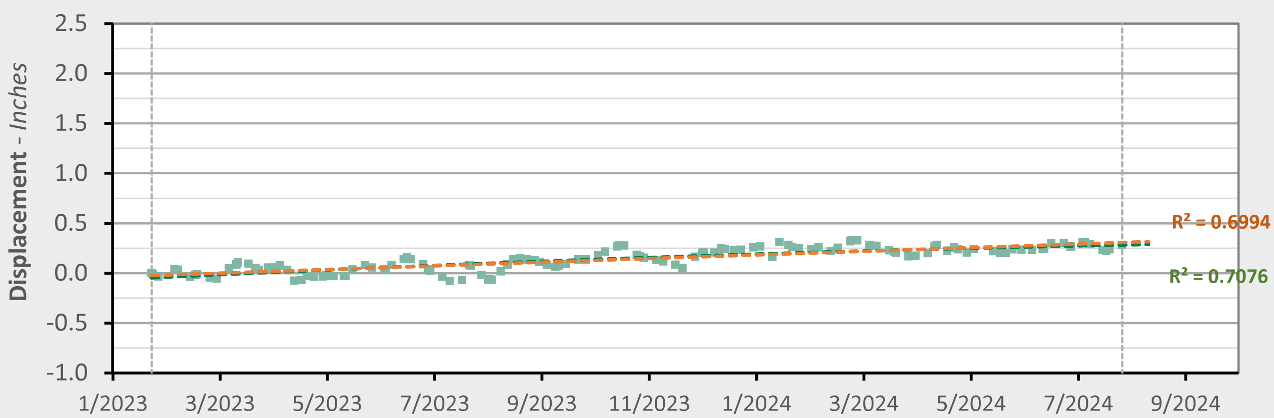
2D Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 5 *(PPG 21)* - Location Map



AOI 5 *(PPG 21)* - East-West Time Series

E-W (7/27/2024) Point Count: 5



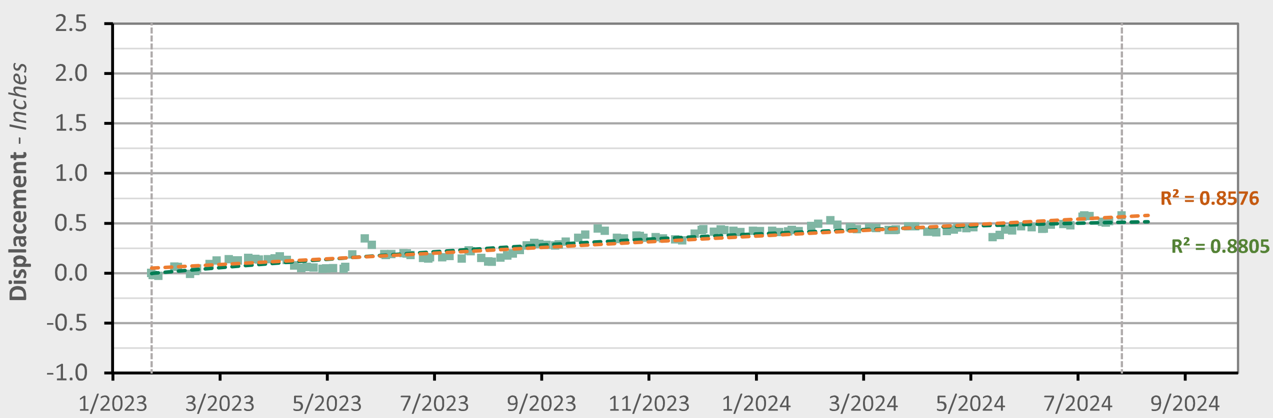
	Nonlinear Trend		Linear Trend	
Velocity:	+0.13	in/yr	+0.22	in/yr
Acceleration:	-0.12	in/yr^2	0.00	in/yr^2

2D Displacement Measurement | Nonlinear Trend Line (Quadratic Regression) | Linear Trend Line (Linear Regression)

AOI 6 *(PPG 6)* - Location Map

AOI 6 *(PPG 6)* - East-West Time Series

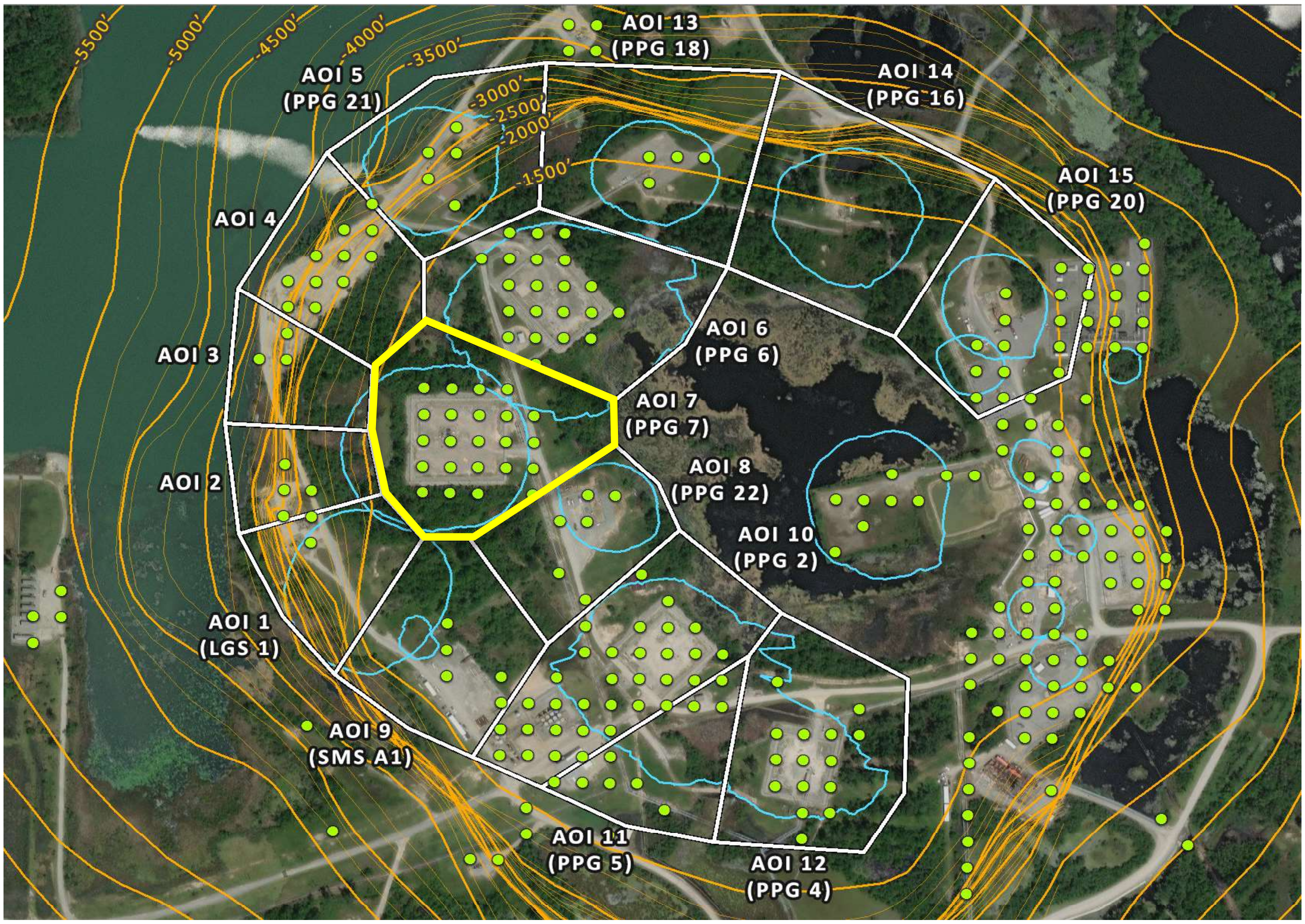
E-W (7/27/2024) Point Count: **21**



	Nonlinear Trend	Linear Trend
Velocity:	+0.13 in/yr	+0.34 in/yr
Acceleration:	-0.28 in/yr^2	0.00 in/yr^2

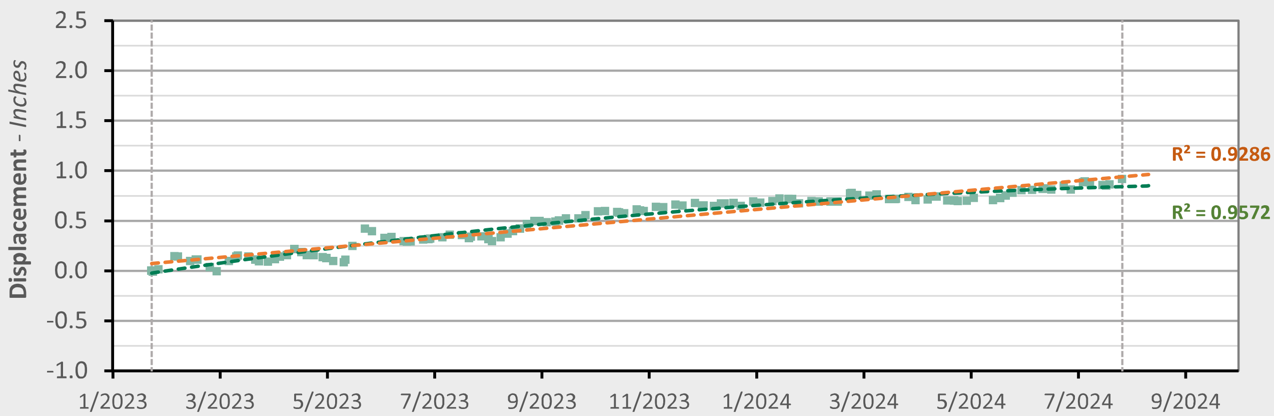
2D Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 7 *(PPG 7)* - Location Map



AOI 7 *(PPG 7)* - East-West Time Series

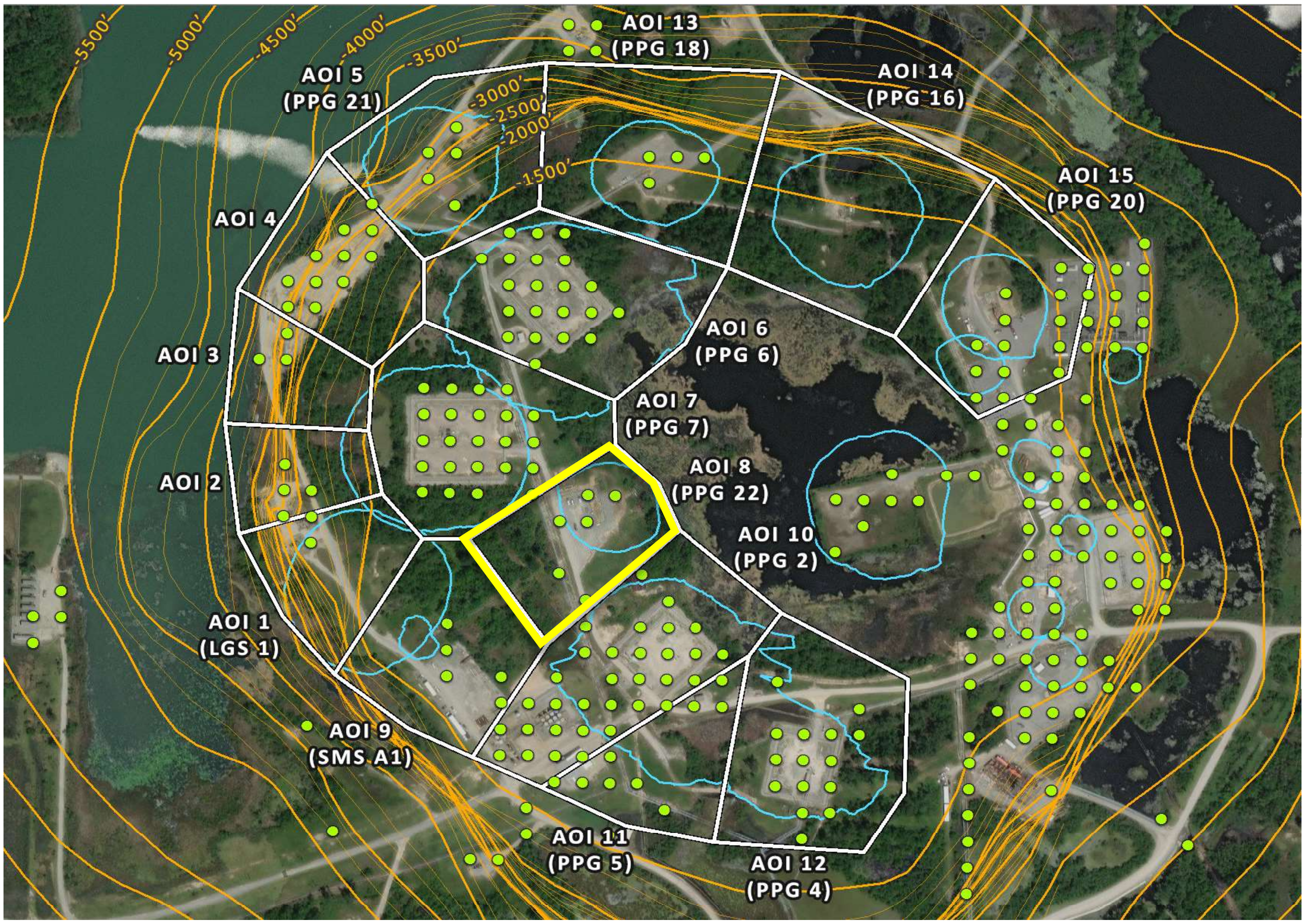
E-W (7/27/2024) Point Count: **23**



	Nonlinear Trend	Linear Trend
Velocity:	+0.19 in/yr	+0.58 in/yr
Acceleration:	-0.52 in/yr^2	0.00 in/yr^2

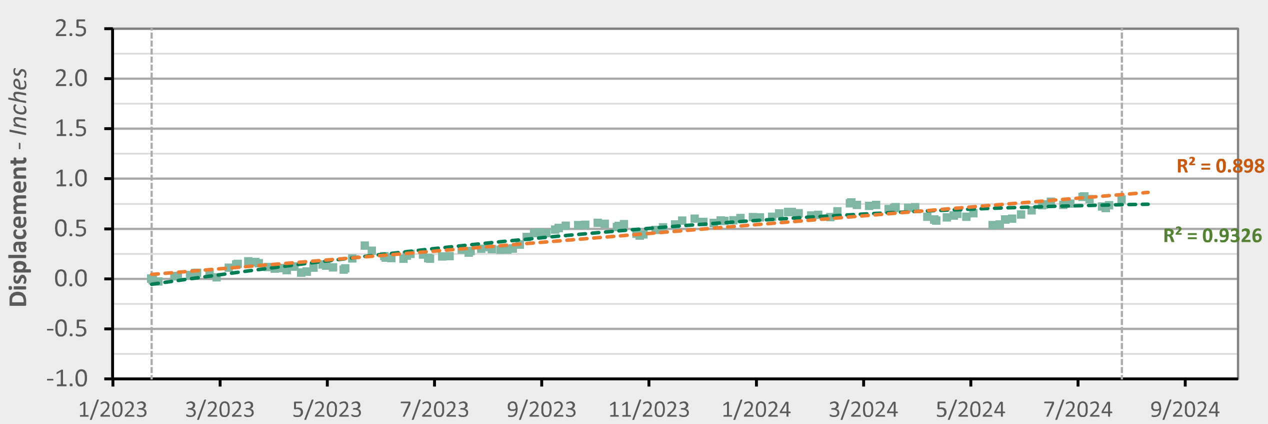
2D Displacement Measurement
Nonlinear Trend Line (Quadratic Regression)
Linear Trend Line (Linear Regression)

AOI 8 *(PPG 22)* - Location Map



AOI 8 *(PPG 22)* - East-West Time Series

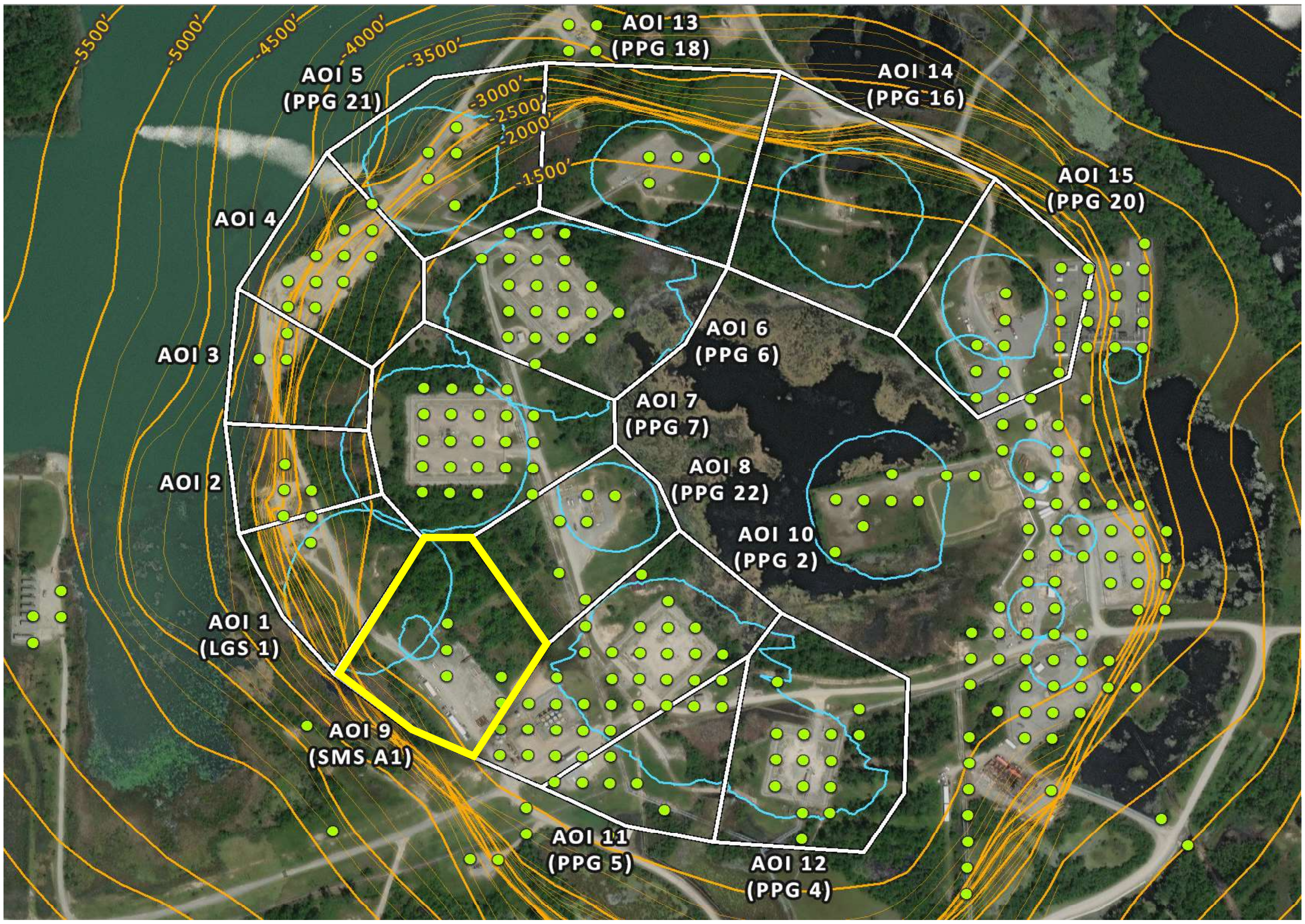
E-W (7/27/2024) Point Count: **6**



	Nonlinear Trend	Linear Trend
Velocity:	+0.13 in/yr	+0.53 in/yr
Acceleration:	-0.53 in/yr^2	0.00 in/yr^2

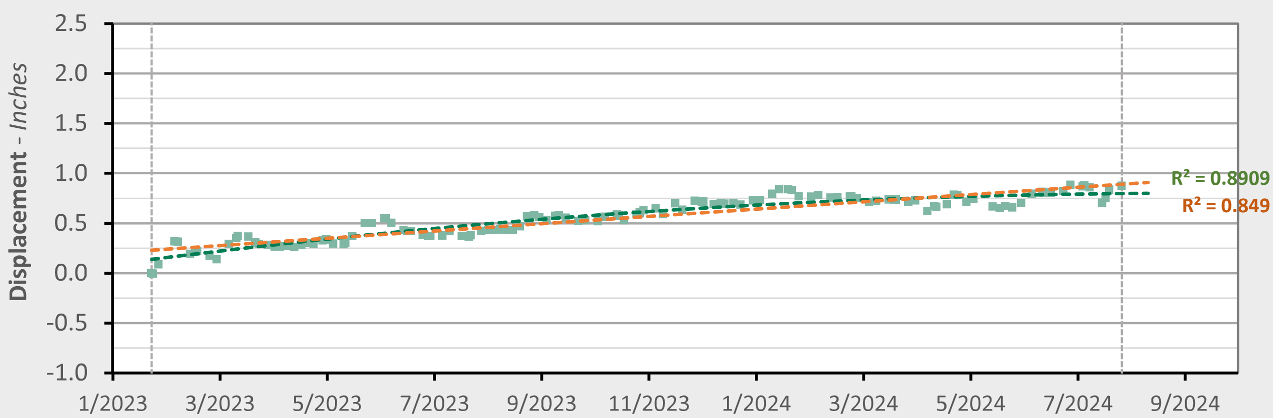
2D Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 9 *(PPG A1)* - Location Map



AOI 9 *(SMS A1)* - East-West Time Series

E-W (7/27/2024) Point Count: **5**



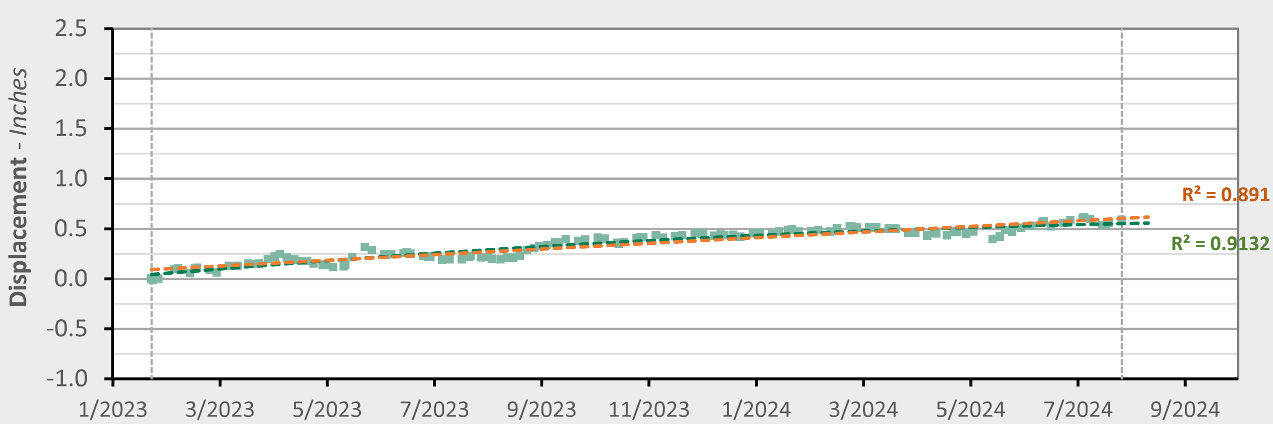
	Nonlinear Trend	Linear Trend
Velocity:	+0.06 in/yr	+0.44 in/yr
Acceleration:	-0.50 in/yr^2	0.00 in/yr^2

2D Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 10 *(PPG 2)* - Location Map

AOI 10 *(PPG 2)* - East-West Time Series

E-W (7/27/2024) Point Count: **32**



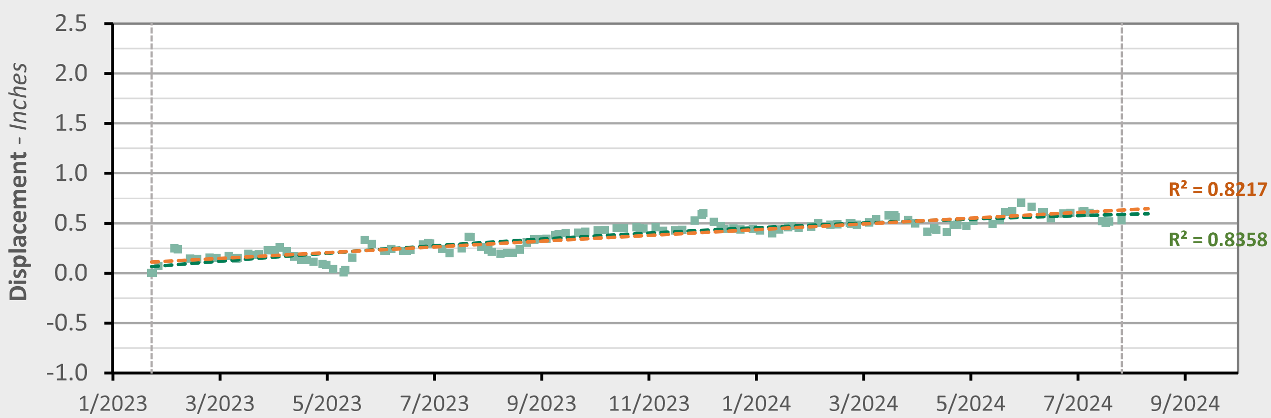
	Nonlinear Trend	Linear Trend
Velocity:	+0.13 in/yr	+0.34 in/yr
Acceleration:	-0.27 in/yr^2	0.00 in/yr^2

2D Displacement Measurement | Nonlinear Trend Line (Quadratic Regression) | Linear Trend Line (Linear Regression)

AOI 11 *(PPG 5)* - Location Map

AOI 11 *(PPG 5)* - East-West Time Series

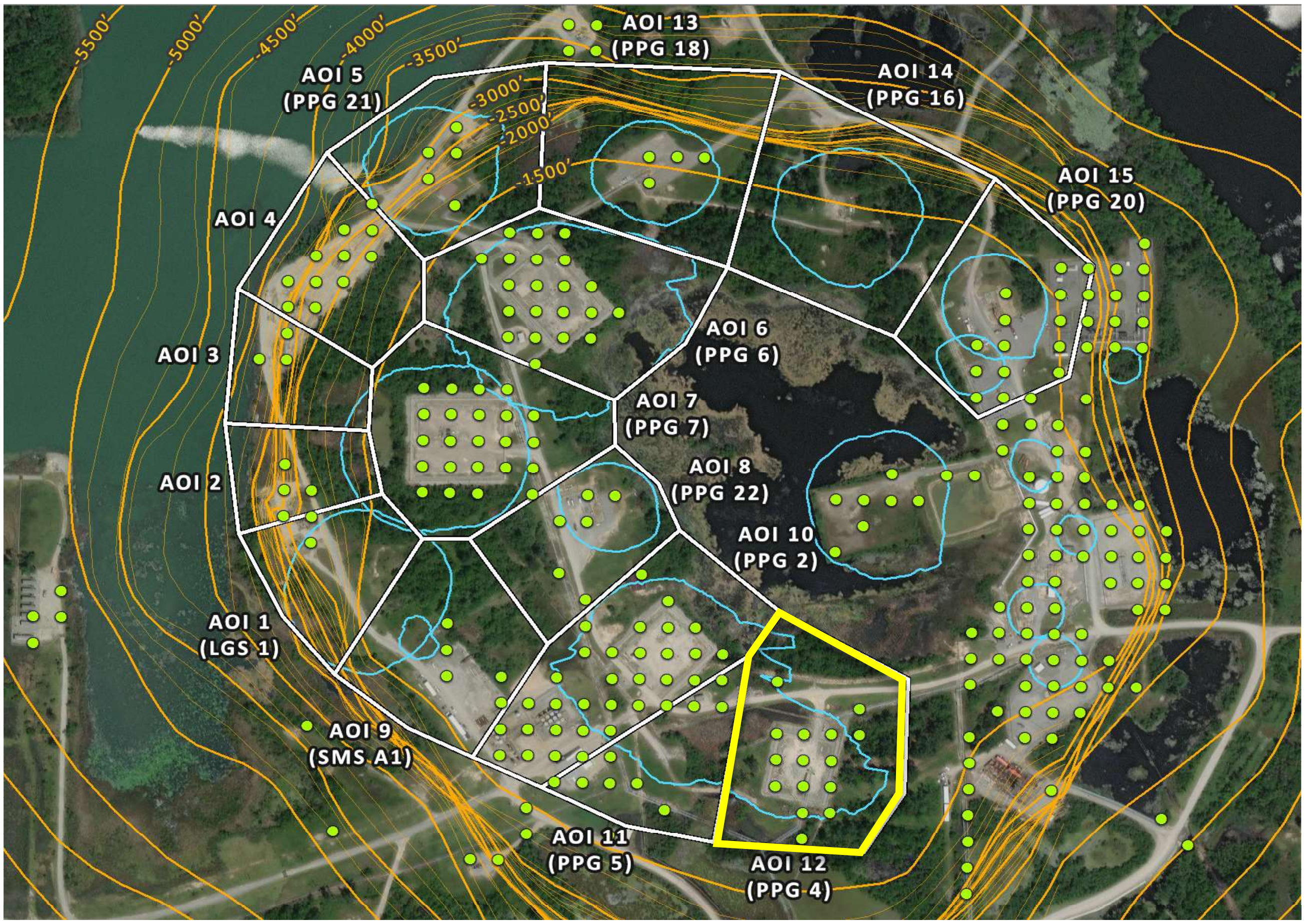
E-W (7/27/2024) Point Count: 9



	Nonlinear Trend	Linear Trend
Velocity:	+0.17 in/yr	+0.35 in/yr
Acceleration:	-0.23 in/yr^2	0.00 in/yr^2

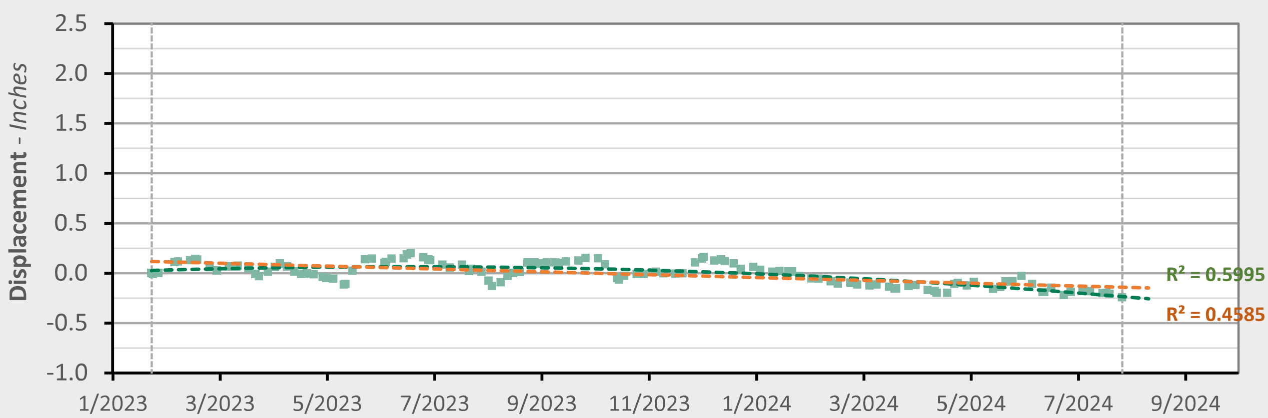
2D Displacement Measurement
Nonlinear Trend Line (Quadratic Regression)
Linear Trend Line (Linear Regression)

AOI 12 *(PPG 4)* - Location Map



AOI 12 *(PPG 4)* - East-West Time Series

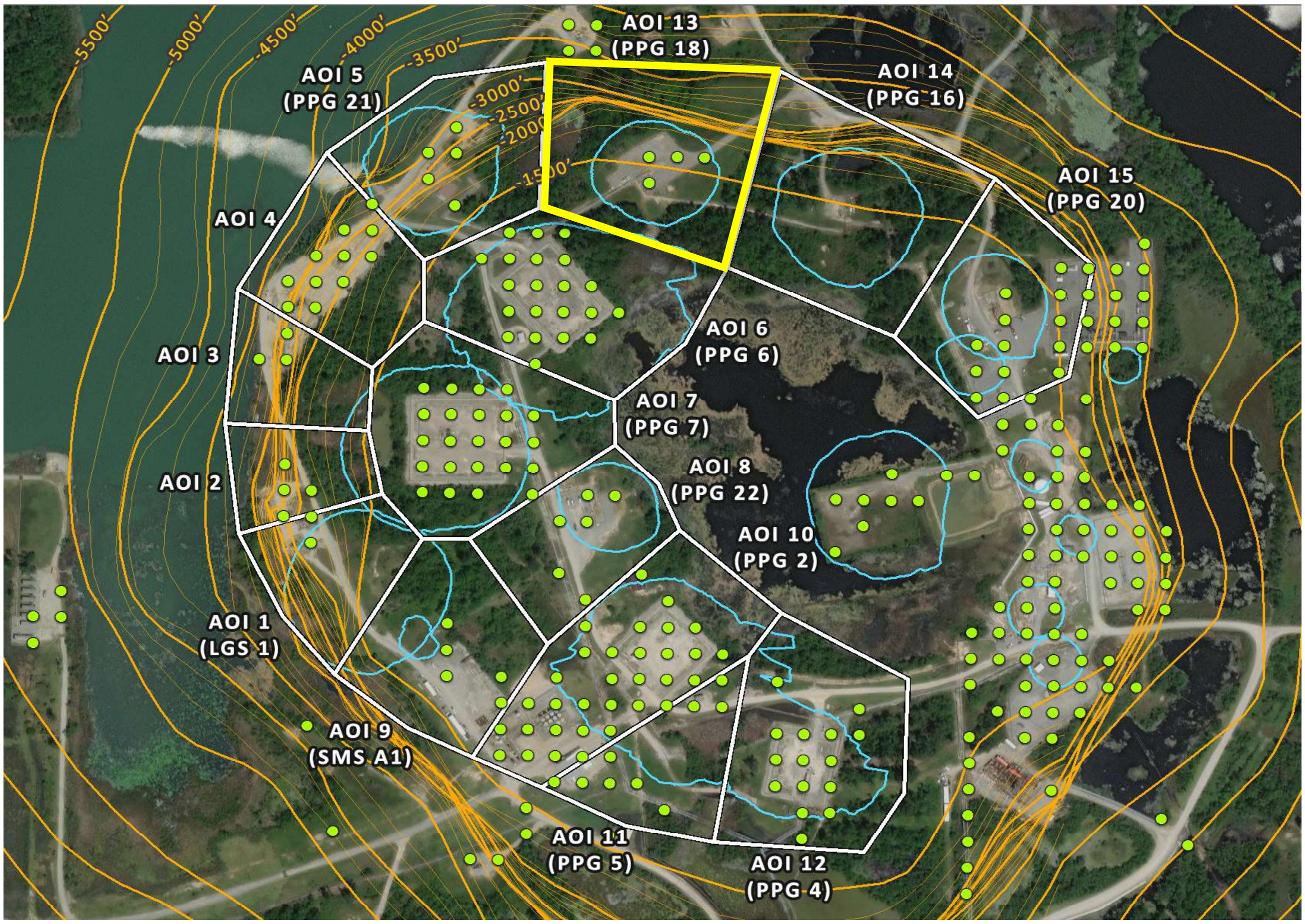
E-W (7/27/2024) Point Count: **15**



	Nonlinear Trend	Linear Trend
Velocity:	-0.54 in/yr	-0.17 in/yr
Acceleration:	-0.49 in/yr^2	0.00 in/yr^2

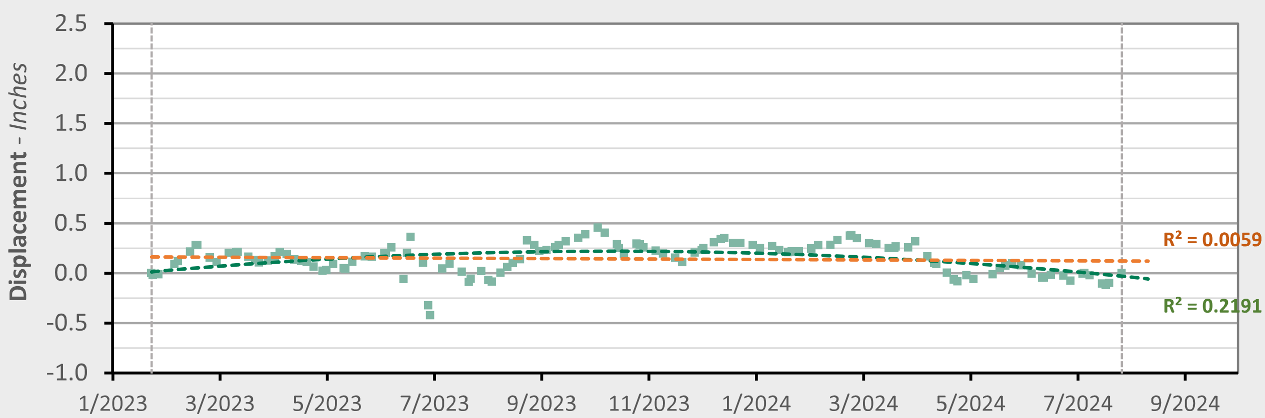
2D Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 13 *(PPG 18)* - Location Map



AOI 13 *(PPG 18)* - East-West Time Series

E-W (7/27/2024) Point Count: 4



	Nonlinear Trend	Linear Trend
Velocity:	-0.64 in/yr	-0.03 in/yr
Acceleration:	-0.81 in/yr^2	0.00 in/yr^2

2D Displacement Measurement
Nonlinear Trend Line (Quadratic Regression)
Linear Trend Line (Linear Regression)

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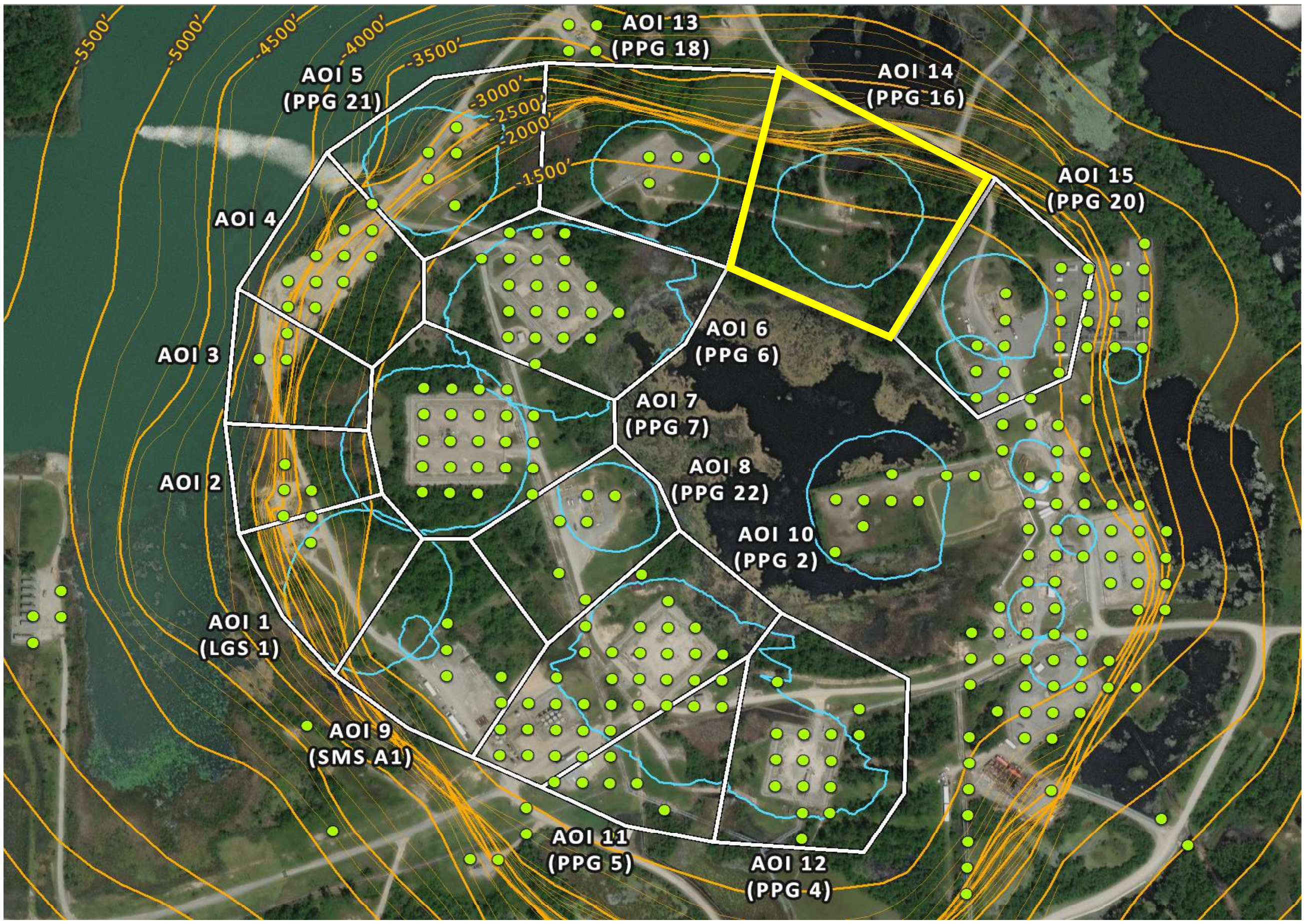
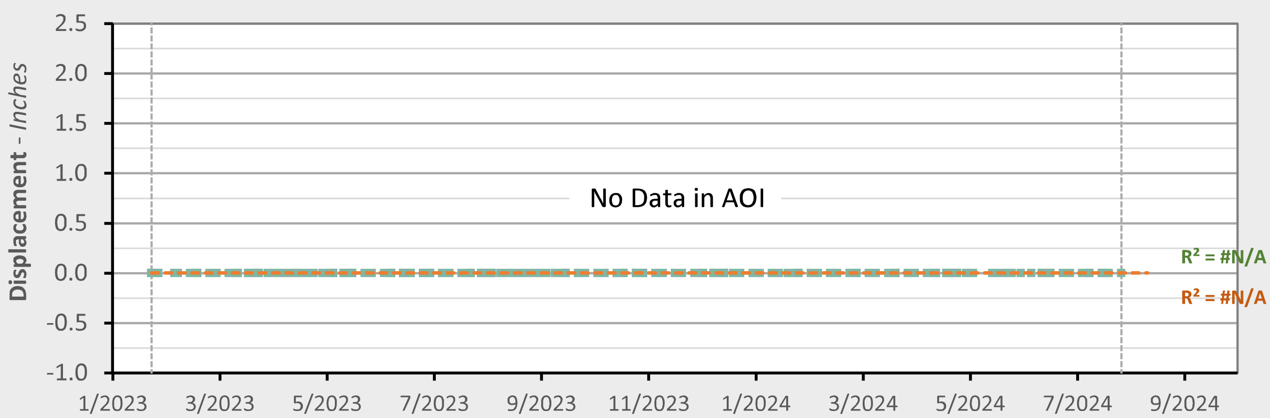
AOI 14 *(PPG 16)* - Location Map



AOI 14 *(PPG 16)* - East-West Time Series

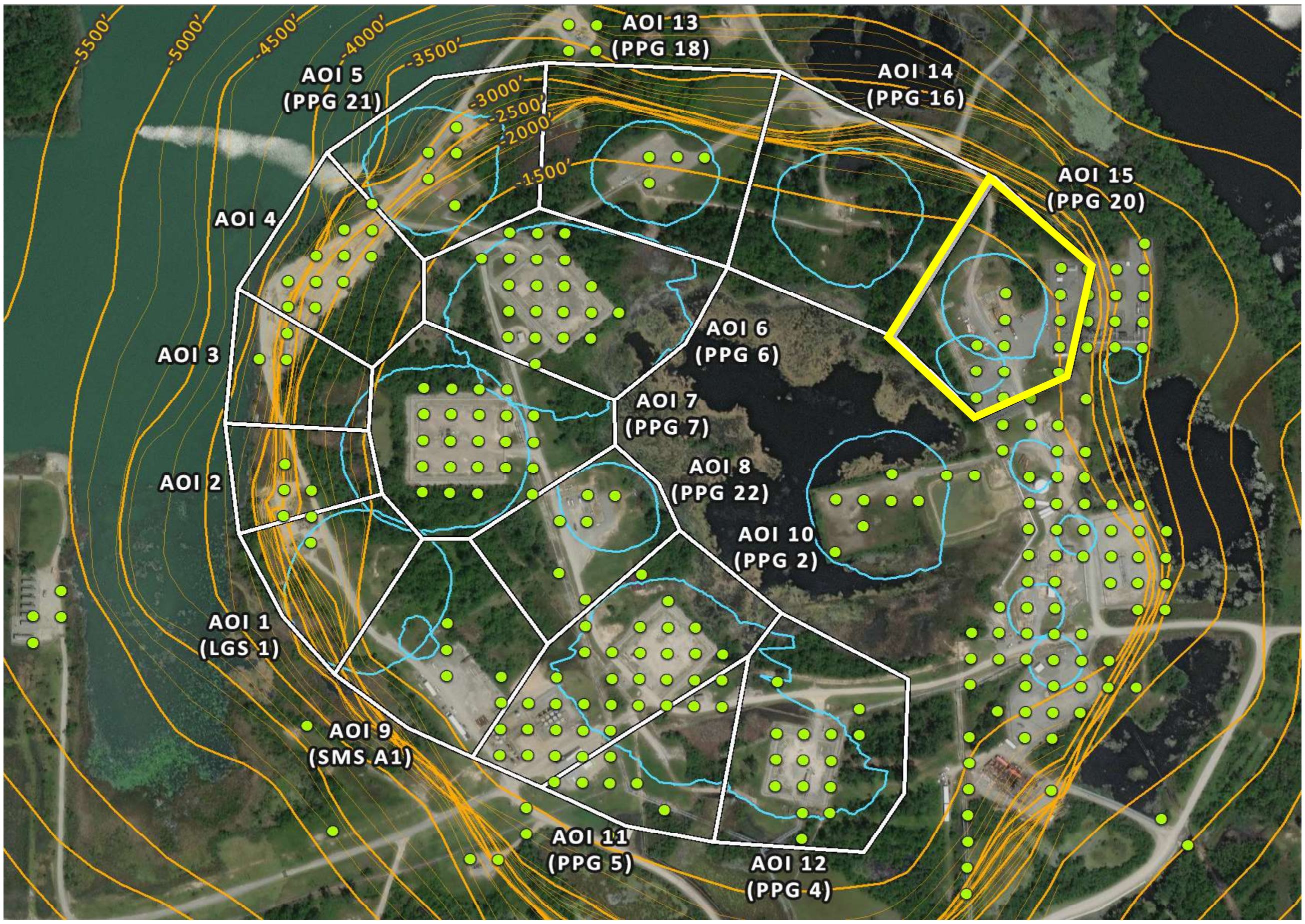
E-W (7/27/2024) Point Count: **0**



	Nonlinear Trend		Linear Trend	
Velocity:	N/A	in/yr	N/A	in/yr
Acceleration:	N/A	in/yr^2	N/A	in/yr^2

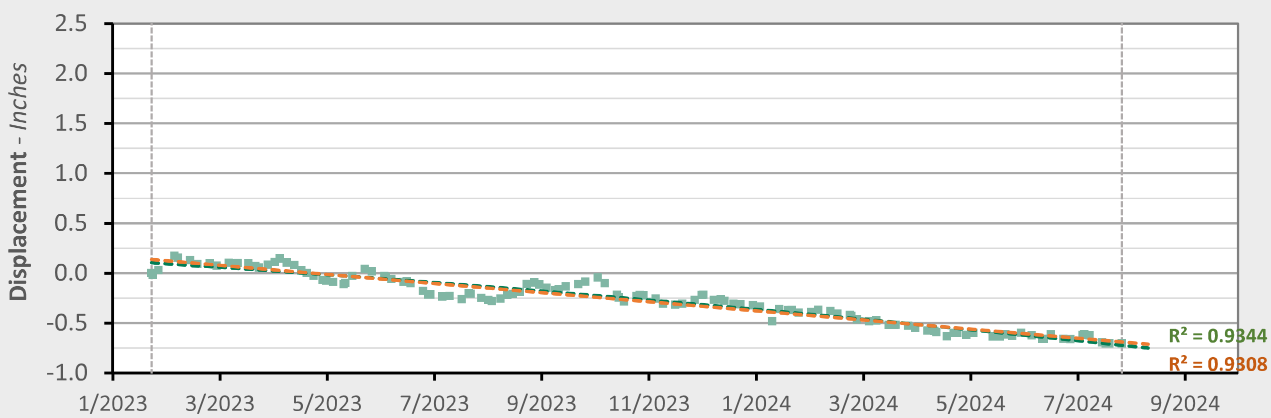
2D Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

AOI 15 *(PPG 20)* - Location Map



AOI 15 *(PPG 20)* - East-West Time Series

E-W (7/27/2024) Point Count: **14**



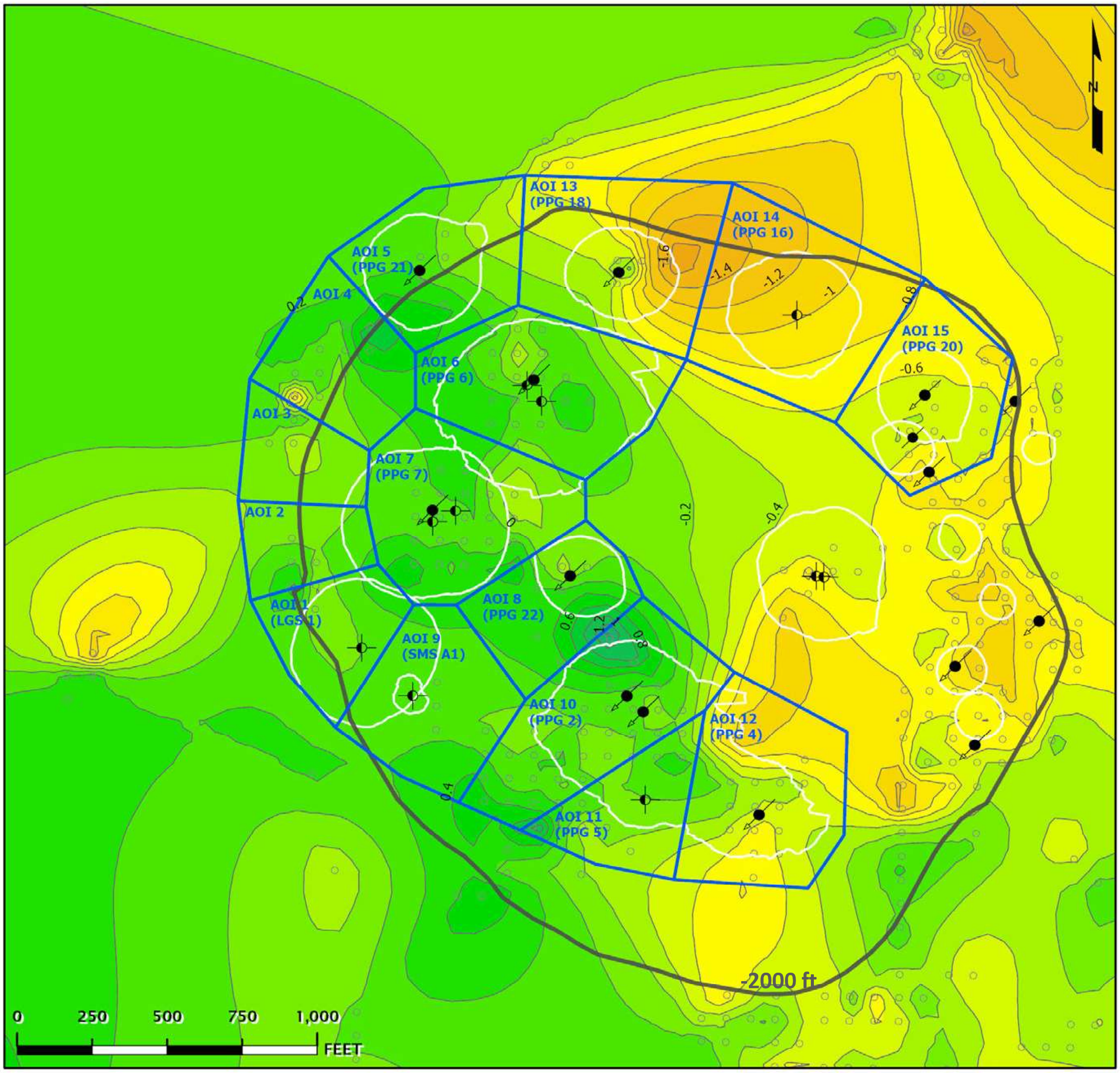
	Nonlinear Trend		Linear Trend	
Velocity:	-0.68	in/yr	-0.55	in/yr
Acceleration:	-0.18	in/yr^2	0.00	in/yr^2

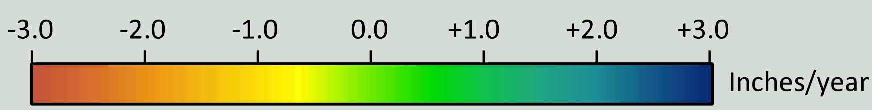
2D Displacement Measurement — Nonlinear Trend Line (Quadratic Regression) — Linear Trend Line (Linear Regression)

East-West Data (01/24/2023 - 07/27/2024)

Nonlinear Velocity Contours

As of date: 07/27/2024





AOI Boundary · InSAR LOS Measurement Point · Contour (0.2)

Historical Cavern Extent · Top of Dome (-2000 ft Contour)

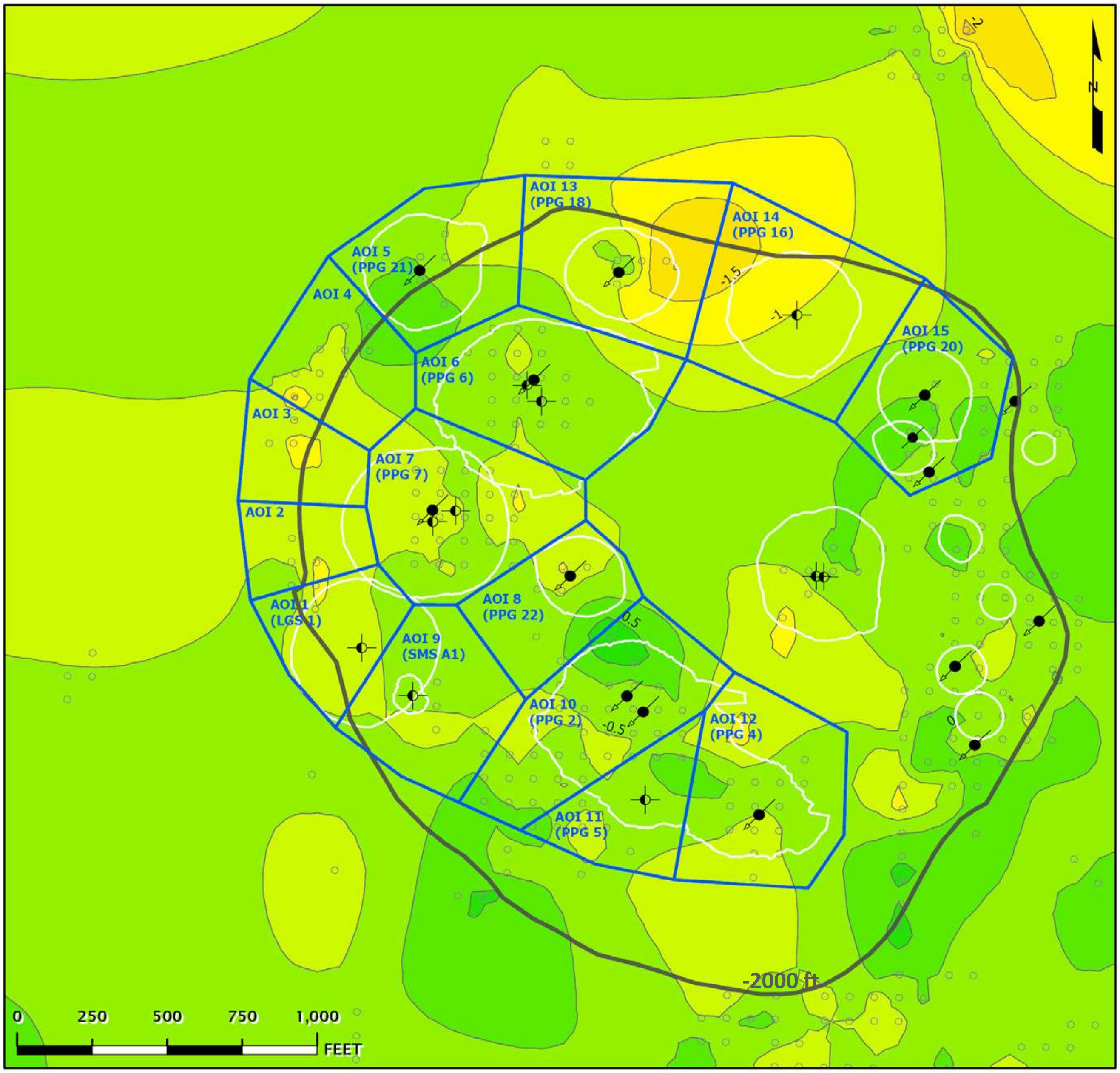
Cavern Well Surface Locations

09 - Active - Injection · 29 - Dry and Plugged

East-West Data (01/24/2023 - 07/27/2024)

Nonlinear Acceleration Contours

Date range: 01/24/2023 - 07/27/2024



-6.0 -4.0 -2.0 0.0 +2.0 +4.0 +6.0 Inches/year²

AOI Boundary
InSAR LOS Measurement Point
Contour (0.5)
Historical Cavern Extent
Top of Dome (-2000 ft Contour)

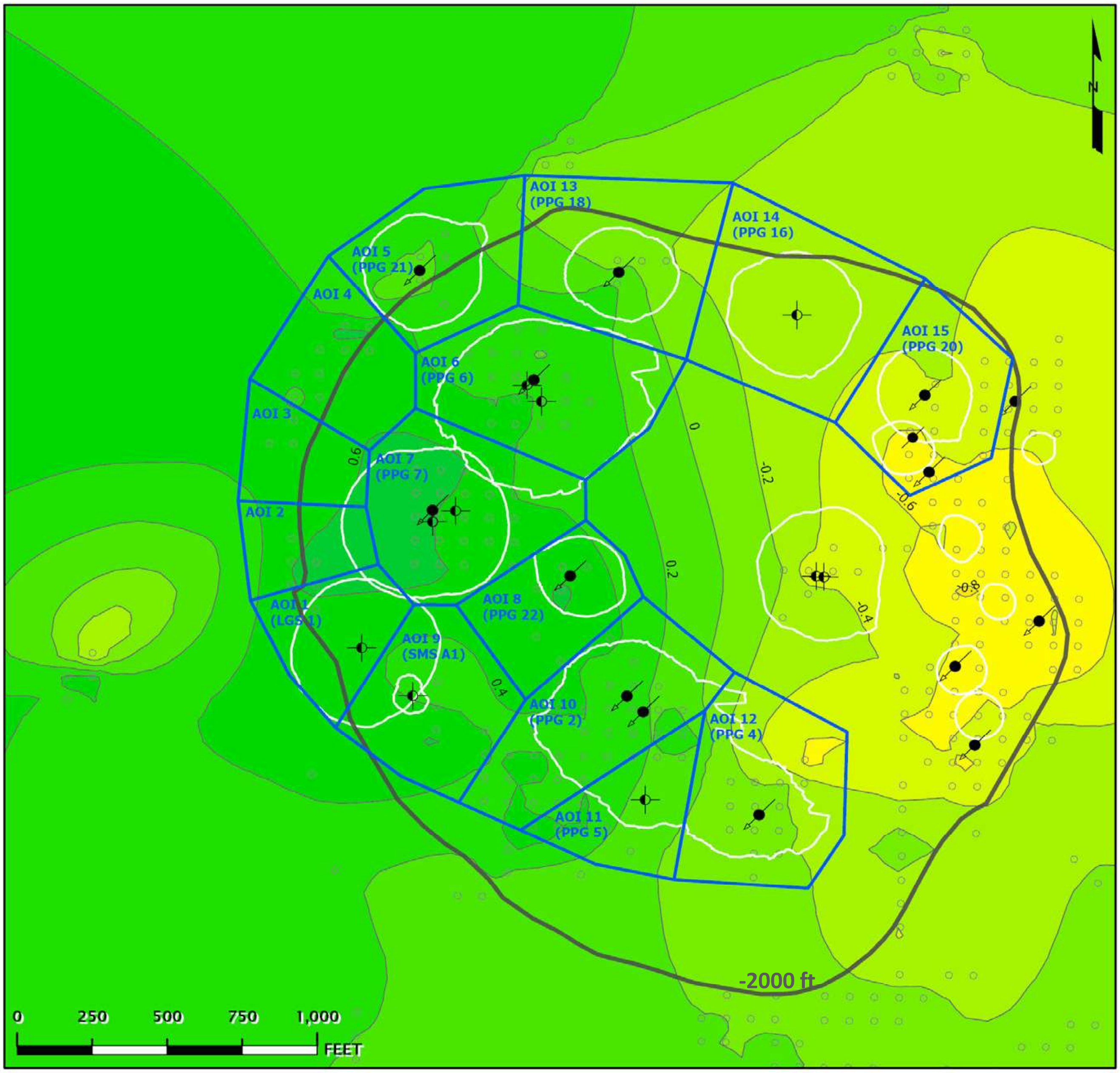
Cavern Well Surface Locations

09 - Active - Injection
29 - Dry and Plugged

East-West Data (01/24/2023 - 07/27/2024)

Linear Velocity Contours

Date range: 01/24/2023 - 07/27/2024



-3.0 | -2.0 | -1.0 | 0.0 | +1.0 | +2.0 | +3.0 Inches/year

AOI Boundary
InSAR LOS Measurement Point
Contour (0.2)
Historical Cavern Extent
Top of Dome (-2000 ft Contour)

Cavern Well Surface Locations

09 - Active - Injection
29 - Dry and Plugged