Westlake US 2
Received 9/18/2023

TSX/PAZ Satellite
Update InSAR
Subsidence
September 16, 2023

Longuist comment:

"The PAZ satellite from the TSX/PAZ constellation (4 & 7-day revisit) passed by Sulphur on Saturday September 16. We received the dataset today and noted that the latest data point is closer to the linear trend than the prior point. The attached time series plots have been prepared for reference."

Submitted by: Nathaniel Byars (Lonquist)

TSX/PAZ Constellation Update

Continuous InSAR Monitoring of Ground Displacement Near Western Caverns and Dome Flank

Sulphur Dome
Westlake Chemicals

September 16, 2023 Update

Date Signed: September 18, 2023
Austin, TX

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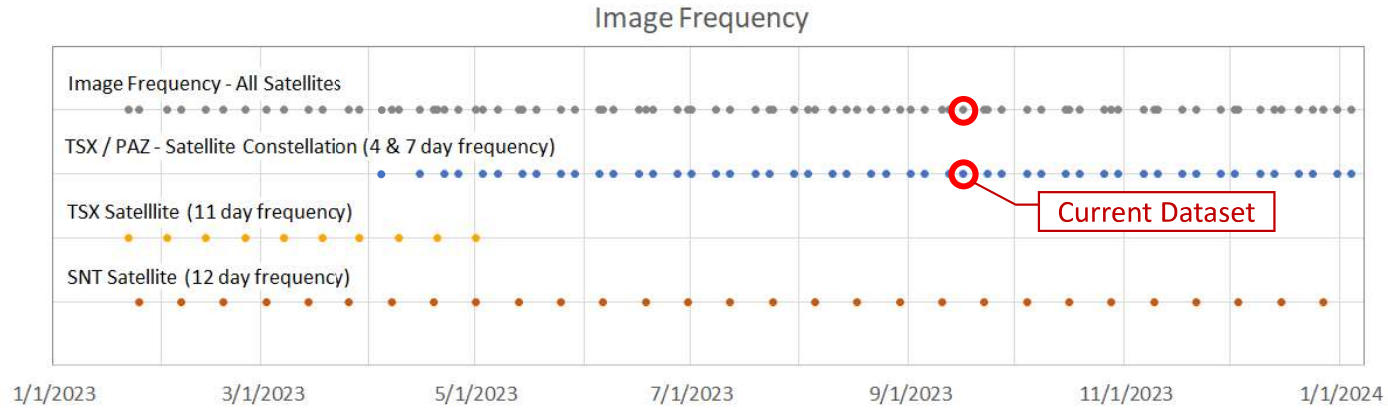
Principal Engineer
Louisiana License No. 40697

LONQUIST & CO. LLC
PETROLEUM ENGINEERS | ENERGY ADVISORS

Parameters of InSAR Dataset and Collection Frequency

- Satellite Data Delivery Frequency as of April 2023:
  - Sentinel 1 (SNT) 12 days
  - TSX / PAZ Constellation 4 & 7 days
  - 3.96-day avg. frequency

			TSX/PAZ Constellation	
	Sentinel-1	TerraSAR-X	TerraSAR-X	PAZ
Mode / Resolution	16 x 65 ft	Spotlight (3 x 3 ft)	Spotlight (3 x 3 ft)	Spotlight (3 x 3 ft)
Track	T136	T29	T67	T120
Band (wavelength)	C-Band (2.32 in)	X-Band (1.22 in)	X-Band (1.22 in)	X-Band (1.22 in)
Nominal frequency	12- day	11- day	11- day	11- day
Orbit (LOS angle)	Ascending 43°	Descending 17°	Descending 37°	Descending 37°
Date range	04 Oct 2016 – 20 Jan 2024	16 Jun 2022 – 01 May 2023	24 Jan 2023 – 11 Jan 2024	28 Jan 2023 – 15 Jan 2024
Number of images	199	30	34	33



Overview and Monitoring History

- Beginning in late January, ground displacement over the western portion of the Sulphur Mines Salt Dome has been evaluated following the delivery of each dataset update from TRE-Altamira
- An automated process and set of deliverables to convey the results of the datasets is being considered that will evaluate multiple factors including trend consistency and mapped acceleration of ground displacement
- Current updates are focused on the review of time series charts of averaged data for selections of points around the dome and caverns on the western flank
- The TSX/PAZ satellite constellation (4 & 7-day revisit) passed by Sulphur on Saturday September 16, 2023
- The following slides present the time series and associated linear trends for each location evaluated from this dataset
- The prior recent updates from the TSX/PAZ satellite constellation have begun to show some below trend measurements in the areas reviewed, although less pronounced in the most recent measurement. This is also occurring in certain areas further away from the dome. TREA is currently reprocessing the TSX/PAZ dataset in an effort to confirm the accuracy of the measurements due to these observations.

TSX/PAZ Constellation – September 16, 2023 Update

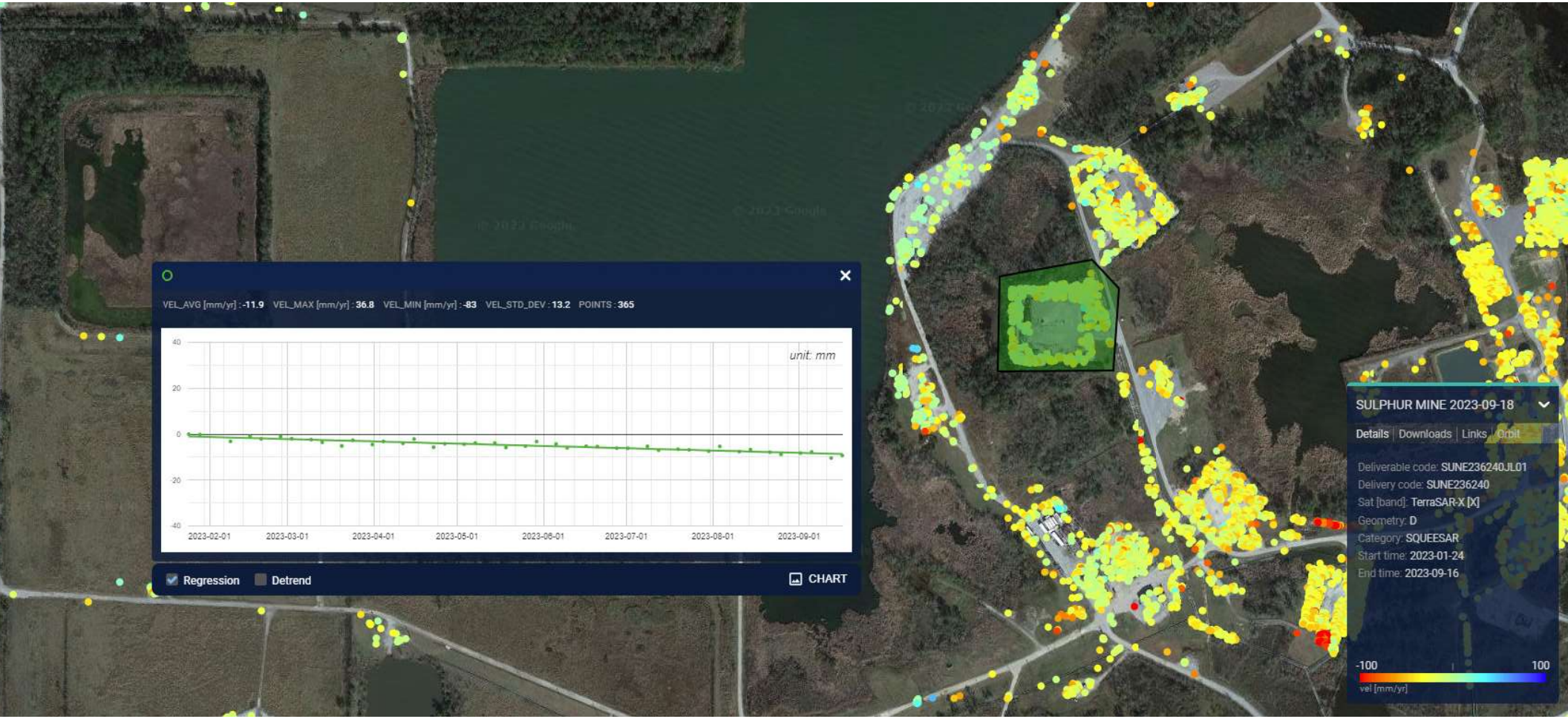
PPG 21


VEL_AVG [mm/yr] : -10.1 VEL_MAX [mm/yr] : 38.9 VEL_MIN [mm/yr] : -72.8 VEL_STD_DEV : 18.5 POINTS : 128
unit: mm
40
20
0
-20
-40
2023-02-01
2023-03-01
2023-04-01
2023-05-01
2023-06-01
2023-07-01
2023-08-01
2023-09-01
Regression
Detrend
CHART
SULPHUR MINE 2023-09-18
Details | Downloads | Links | Orbit
Deliverable code: SUNE236240JL01
Delivery code: SUNE236240
Sat [band]: TerraSAR-X [X]
Geometry: D
Category: SQUEESAR
Start time: 2023-01-24
End time: 2023-09-16
-100
100
vel [mm/yr]

PPG 6


VEL_AVG [mm/yr] : -17.9
VEL_MAX [mm/yr] : 43
VEL_MIN [mm/yr] : -88
VEL_STD_DEV : 17.3
POINTS : 443
unit: mm
40
20
0
-20
-40
2023-02-01
2023-03-01
2023-04-01
2023-05-01
2023-06-01
2023-07-01
2023-08-01
2023-09-01
Regression
Detrend
CHART
SULPHUR MINE 2023-09-18
Details
Downloads
Links
Orbit
Deliverable code: SUNE236240JL01
Delivery code: SUNE236240
Sat [band]: TerraSAR-X [X]
Geometry: D
Category: SQUEESAR
Start time: 2023-01-24
End time: 2023-09-16
-100
100
vel [mm/yr]

PPG 7


VEL_AVG [mm/yr] : -11.9 VEL_MAX [mm/yr] : 36.8 VEL_MIN [mm/yr] : -83 VEL_STD_DEV : 13.2 POINTS : 365
unit: mm
40
20
0
-20
-40
2023-02-01
2023-03-01
2023-04-01
2023-05-01
2023-06-01
2023-07-01
2023-08-01
2023-09-01
Regression
Detrend
CHART
SULPHUR MINE 2023-09-18
Details | Downloads | Links | Orbit
Deliverable code: SUNE236240JL01
Delivery code: SUNE236240
Sat [band]: TerraSAR-X [X]
Geometry: D
Category: SQUEESAR
Start time: 2023-01-24
End time: 2023-09-16
-100
100
vel [mm/yr]

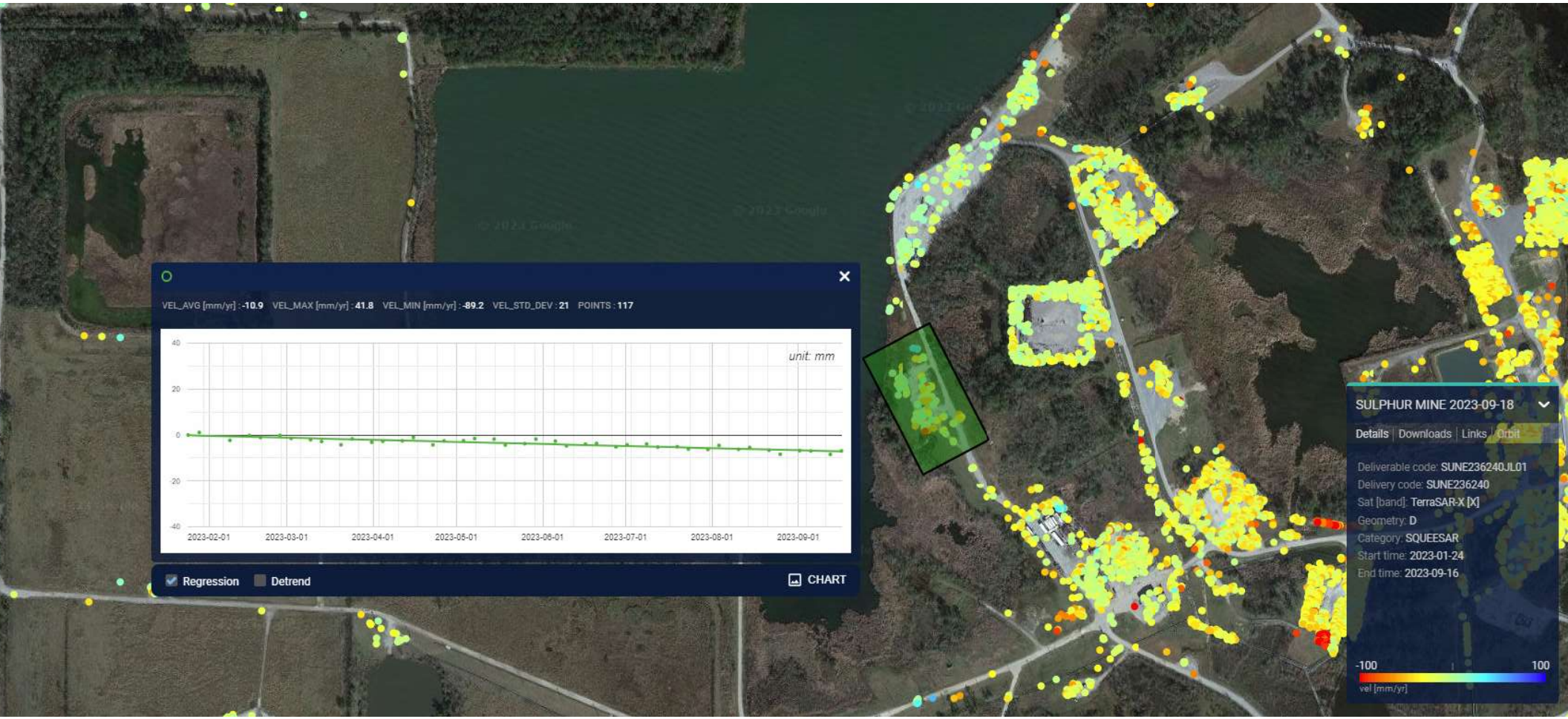
PPG 22


VEL_AVG [mm/yr] : -24 VEL_MAX [mm/yr] : 16.8 VEL_MIN [mm/yr] : -102.8 VEL_STD_DEV : 18.4 POINTS : 108
unit: mm
40
20
0
-20
-40
2023-02-01
2023-03-01
2023-04-01
2023-05-01
2023-06-01
2023-07-01
2023-08-01
2023-09-01
Regression
Detrend
CHART
SULPHUR MINE 2023-09-18
Details | Downloads | Links | Orbit
Deliverable code: SUNE236240JL01
Delivery code: SUNE236240
Sat [band]: TerraSAR-X [X]
Geometry: D
Category: SQUEESAR
Start time: 2023-01-24
End time: 2023-09-16
-100
100
vel [mm/yr]

AOI #1


VEL_AVG [mm/yr] : -20.1 VEL_MAX [mm/yr] : 42.6 VEL_MIN [mm/yr] : -81.5 VEL_STD_DEV : 20.8 POINTS : 194
unit: mm
40
20
0
-20
-40
2023-02-01
2023-03-01
2023-04-01
2023-05-01
2023-06-01
2023-07-01
2023-08-01
2023-09-01
Regression
Detrend
CHART
SULPHUR MINE 2023-09-18
Details | Downloads | Links | Orbit
Deliverable code: SUNE236240JL01
Delivery code: SUNE236240
Sat [band]: TerraSAR-X [X]
Geometry: D
Category: SQUEESAR
Start time: 2023-01-24
End time: 2023-09-16
-100
100
vel [mm/yr]

AOI #2


VEL_AVG [mm/yr] : -10.9 VEL_MAX [mm/yr] : 41.8 VEL_MIN [mm/yr] : -89.2 VEL_STD_DEV : 21 POINTS : 117
unit: mm
40
20
0
-20
-40
2023-02-01
2023-03-01
2023-04-01
2023-05-01
2023-06-01
2023-07-01
2023-08-01
2023-09-01
Regression
Detrend
CHART
SULPHUR MINE 2023-09-18
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Deliverable code: SUNE236240JL01
Delivery code: SUNE236240
Sat [band]: TerraSAR-X [X]
Geometry: D
Category: SQUEESAR
Start time: 2023-01-24
End time: 2023-09-16
-100
100
vel [mm/yr]

AOI #3


VEL_AVG [mm/yr] : 0.6 VEL_MAX [mm/yr] : 37.3 VEL_MIN [mm/yr] : -50.7 VEL_STD_DEV : 12 POINTS : 144
unit: mm
40
20
0
-20
-40
2023-02-01
2023-03-01
2023-04-01
2023-05-01
2023-06-01
2023-07-01
2023-08-01
2023-09-01
Regression
Detrend
CHART
SULPHUR MINE 2023-09-18
Details | Downloads | Links | Orbit
Deliverable code: SUNE236240JL01
Delivery code: SUNE236240
Sat [band]: TerraSAR-X [X]
Geometry: D
Category: SQUEESAR
Start time: 2023-01-24
End time: 2023-09-16
-100
100
vel [mm/yr]

AOI #4


VEL_AVG [mm/yr] : -4
VEL_MAX [mm/yr] : 26
VEL_MIN [mm/yr] : -41.3
VEL_STD_DEV : 13.6
POINTS : 78
unit: mm
40
20
0
-20
-40
2023-02-01
2023-03-01
2023-04-01
2023-05-01
2023-06-01
2023-07-01
2023-08-01
2023-09-01
Regression
Detrend
CHART
SULPHUR MINE 2023-09-18
Details
Downloads
Links
Orbit
Deliverable code: SUNE236240JL01
Delivery code: SUNE236240
Sat [band]: TerraSAR-X [X]
Geometry: D
Category: SQUEESAR
Start time: 2023-01-24
End time: 2023-09-16
-100
100
vel [mm/yr]