Division of Engineering Research on Call Agreement 34652

Task 12 – Change Detection of Inventoried Landslides Using Remote Sensing Techniques

Patrick Bassal, M. Faraz Athar, Charles Toth, Peter Narsavage

Prepared for:

the Ohio Department of Transportation
Office of Statewide Planning and Research

and the
United States Department of Transportation
Federal Highway Administration

November 2023

Final Report

1. Report No. FHWA/OH-2023-26	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Division of Engineering Research on Call Services Task#12 Change Detection of Inventoried Landslides Using Remote Sensing Techniques		**5. Report Date** November 2023 **6. Performing Organization Code**
7. Author(s) Patrick Bassal (ORCID 0000-0003-4153-2460), M. Faraz Athar, Charles Toth, Peter Narsavage (ORCID 0000-0002-1823-9402)		**8. Performing Organization Report No.**
9. Performing Organization Name and Address E.L. Robinson Engineering of Ohio Company 950 Goodale Blvd, Suite 180 Grandview, OH 43212 and The Ohio State University 281 W. Lane Ave. Columbus, OH 43210		**10. Work Unit No. (TRAIS)** **11. Contract or Grant No.** 34652
12. Sponsoring Agency Name and Address Ohio Department of Transportation Office of Statewide Planning and Research 1980 West Broad St. Columbus, OH 43223		**13. Type of Report and Period Covered** Final Report **14. Sponsoring Agency Code**

15. Supplementary Notes
Prepared in cooperation with the Ohio Department of Transportation (ODOT)

16. Abstract
This study evaluates the effectiveness of utilizing remotely sensed three-dimensional (3D) spatial data, including Light Detection and Ranging (lidar) and Interferometric Synthetic Aperture Radar (InSAR) for interpreting change detections of eastern Ohio (Districts 5, 10, and 11) landslides. The performance of lidar methods used by specialty firm Teren were evaluated for their ability to detect 99 inventoried landslides, relative to field inspection surveys. The performance of InSAR methods used by specialty firm EO59 were evaluated for their ability to detect a subset of 15 inventoried landslides, relative to field inspection surveys. Four selected case studies are detailed to showcase the performance of these methods. Ultimately this work is anticipated to support the potential adoption of remote sensing technologies to supplement or substitute current ODOT landslide inventory field surveys. Our research team believes that in the near-term, the integration of lidar-based approaches with the landslide inventory can potentially increase landslide detection reliability and reduce overall costs. InSAR may additionally be considered for either indicating subtle movements for lower risk landslides, or frequently monitoring movements of higher risk landslides.

17. Key Words	18. Distribution Statement
Landslide inventory, remote sensing, LiDAR, InSAR, change detections	No Restrictions. This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	xxx	

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
AREA				
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yards	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
NOTE: Volumes greater than 1000 L shall be shown in m^3.				
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
TEMPERATURE (exact)				
°F	Fahrenheit temperature	5(°F-32)/9 or (°F-32)/1.8	Celsius temperature	°C
ILLUMINATION				
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
FORCE and PRESSURE or STRESS				
lbf	poundforce	4.45	newtons	N
lbf/in^2 or psi	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
AREA				
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
VOLUME				
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.71	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
MASS				
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
TEMPERATURE (exact)				
°C	Celsius temperature	1.8°C + 32	Fahrenheit temperature	°F
ILLUMINATION				
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
FORCE and PRESSURE or STRESS				
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2 or psi

* SI is the symbol for the International Symbol of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.

(Revised September 1993)

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The contents of this report reflect the views of the authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Ohio Department of Transportation or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

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Credits and Acknowledgments

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The authors thank the engineers and geoscientists who provided the geospatial data and assisted with the evaluations of this report, specifically: Jake Opdahl (Teren), John Norman (Teren), Austin Savage (Teren), Alfredo Rocca (EO59), and Carl Pucci (EO59). We also thank Kevin White for his review and recommendations for the report and for performing as the Research-on-Call Project Manager. The research team thanks the Ohio Department of Transportation for their sponsorship of this project. We specifically note the contribution of the Technical Advisory Committee members: Christopher Merklin (ODOT), Stephen Taliaferro (ODOT), Paul Painter (ODOT), and Jory Lombardi (Terracon). Their guidance throughout the project was instrumental for the success of the research. The research team also thanks Ms. Michelle Lucas of the Office of Statewide Planning and Research for her time and assistance.

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CHAPTER 1: INTRODUCTION

1.1 Scope of Work

The Ohio Department of Transportation (ODOT) is interested in evaluating the effectiveness of utilizing remotely sensed three-dimensional (3D) spatial data, including Light Detection and Ranging (lidar) and Interferometric Synthetic Aperture Radar (InSAR) for interpreting change detections of eastern Ohio (Districts 5, 10, and 11) landslides. Approximately 80% of the over 8,300 landslides due for re-inspection during Fiscal Year 2023 were characterized as being lower risk (i.e., Tier 1; out of 4) during their last inspection. However, approximately 10% of landslides that were inspected in Fiscal Year 2022 were found to have progressed to a higher risk tier since their preceding inspection. These observations highlight the increasing risks of landslides in eastern Ohio and the need for more efficient and objective techniques to supplement field inspection efforts by ODOT for their evaluation.

The objective of this project is to evaluate the capabilities of lidar and InSAR change detection methods for interpreting a subset of inventoried landslides relative to ODOT risk categories, Tiers 1-4, which are currently determined from on-site field inspections.

The project goals are:

1. Perform a field visit to understand typical field inspection approaches used by ODOT for characterizing landslides.
2. Evaluate the capabilities and the performance of the lidar methods used by specialty firm Teren to detect a subset of 99 inventoried landslides, relative to field inspection surveys.
3. Evaluate the capabilities and the performance of the InSAR methods used by specialty firm EO59 to detect a subset of 15 inventoried landslides, relative to field inspection surveys.
4. Interpret and describe key case studies that showcase the comparative performance of the lidar and InSAR methods.
5. Discuss the relative advantages and limitations of the proposed remote sensing methods for interpreting landslide occurrence and their impact to ODOT structural assets.
6. Provide recommendations for the potential adoption of these technologies to supplement or substitute current ODOT landslides inventory approaches for risk Tier determination.

1.2 Outline of the Report

Chapter 2 provides a brief background of landslide hazards in eastern Ohio, a summary of current ODOT landslide inventory approaches, and a literature review regarding the current state of practice and research for the adoption of lidar and InSAR methods for landslide inventory updating.

Chapter 3 describes the data availability, processing, and results obtained by Teren and EO59. Teren's dataset was obtained near 99 selected inventoried landslides. Teren's results are separated into two components: (1) the "geohazard polygon" detection and ranking system as

obtained from lidar scans at a single epoch (i.e., one instance of time), and (2) the "change detection polygons" obtained from the comparison of two epochs. EO59's dataset is provided as series of Persistent Scatterer (PS) time series points obtained from Advanced Differential InSAR (A-DInSAR) near 15 of the 99 selected inventoried landslides.

Chapter 4 presents general comparisons of the results from the lidar geohazard detections, lidar change detections, and A-DInSAR derived PSs. Four selected case studies are detailed to showcase the performance of these methods.

Chapter 5 presents a bulleted list describing some of the key relative advantages and limitations of the proposed remote sensing methods for interpreting landslide occurrence and their impact to ODOT structural assets.

Chapter 6 presents the conclusions and recommendations from this work.

Appendix A includes the most relevant details used in this study for the 99 selected inventoried landslides. Appendix B includes a field summary report for a site visit conducted on May 10, 2023 that included 13 inventoried landslide sites of varying risk Tiers. Appendices C and D include resources and presentations provided by Teren and EO59, respectively, which were considered for interpreting their provided datasets.

CHAPTER 2: BACKGROUND

2.1 Landslides in Eastern Ohio

Although the occurrence of landslides is generally rare in much of Ohio, the eastern portion of the state is characterized by hilly terrain that poses a landslide risk along Ohio roadways. The most prevalent outcropping geologic units in eastern Ohio are the Pennsylvanian-age Conemaugh and Monongahela groups, and the Permian-age Dunkard group (e.g., Fisher et al. 1968, Hansen 1995). Weak shales and mudstones known as "red beds" are abundant within these geologic units. The red beds are highly susceptible to weathering and strength loss when saturated with water (Schumacher et al. 2013). Slip failures along these red beds account for about 85% of landslides in eastern Ohio (Hansen 1995).

The most common types of landslides in eastern Ohio are rotational slides and flows (Fisher et al. 1968). Rotational slides are characterized as a large moving mass of sediment along a curved failure surface, exhibiting zones of rupture (scarps) and depressions along the crest of the slide and bulging at the toe of the slide. The rate of movement of a rotational slide can vary significantly. Flows are relatively smaller and often slower downslope movements consisting of mixed sediments displacing in a viscous manner with inconsistent shear surfaces. Other landslides in Ohio may occur as translational slides, lateral spreads, or complex slides (e.g., a combination of the mechanisms mentioned). Only debris (coarse-grained soils) and earth (fine-grained soils) landslides are considered here-in; not rock slides. Landslides in Ohio are often caused by over-steepened slopes due to erosion or construction activities, increased weight due to rain and meltwater or construction activities, increased soil pore pressures due to rain infiltration, and removal of vegetation.

2.2 Current ODOT Landslide Inventory

The ODOT landslide inventory (ODOT 2023a) was first developed by the Office of Geotechnical Engineering (OGE) in 2007 to identify and characterize potential landslide hazards along state roadways, assess their relative risks, and establish monitoring and mitigation protocols. The ODOT Landslide Dashboard database (ODOT 2023b) lists 10,263 active landslides at the time of this report, with 139 new landslides added to the database over the past year. The level of data collection and the re-inspection frequency for each landslide site depends on their assigned risk Tier.

The risk Tier is determined according to observed landslide characteristics and professional judgement from field inspections per the landslide inventory manual. Each soil slope is particularly evaluated based on two criteria: (1) the probability of additional movement of the slope (i.e., an occurrence score of 1 to 4), and (2) the probability of significant impact to an ODOT asset or adjacent property or feature (i.e., an impact score of 1 to 4). The product of the occurrence and impact scores provides a Tier Determination Score of 1 to 16, that is then translated to an overall risk Tier of 1 to 4 according to Table 1.

The level of data collection during the field inspection then proceeds according to the assigned Tier. Tier 1 data collection includes photographic documentation, estimation of the slide

geometry (e.g., depth, height, slope angle, length), progression since last inspection, as well as past remediation, maintenance, and accidents. Tier 2 sites additionally require details regarding the geometric and traffic data, type of landslide movement, rate of movements, possible cause of landslide, impact to assets, soil origin and type, and measurements of roadway cracks and dips. Tier 3 and 4 sites additionally require the collection of hydrological data, including the presence of groundwater or surface water, or other potential hydraulic maintenance issues.

Table 1.1. Tier based on Tier Determination Score (ODOT 2023a)

Tier Determination Score	Tier Action
1 or 2	**Tier 1 Site** No Detailed Rating Needed
3 or 4	**Tier 2 Site** Detailed Rating Needed
6, 8, or 9	**Tier 3 Site** Detailed Rating Needed
12 or 16	**Tier 4 Site** Detailed Rating Needed

The Landslide Dashboard (ODOT 2023b) currently indicates that of the total active landslide sites, 80.1% are Tier 1, 12.5% are Tier 2, 6.8% are Tier 3, and 0.4% (or 39 landslides) are Tier 4. Tier 1 sites are re-inspected every 5 years, Tier 2 sites are re-inspected every 3 years, Tier 3 sites are re-inspected every 2 years, and Tier 4 sites are re-inspected annually. However, field inspections require significant resources to keep up with this pace. Over 75% of the sites are due for re-inspection according to current estimates in the dashboard.

2.3 Landslide Inventories from Lidar

Airborne laser scanning with lidar has been widely used for the characterization, detection, hazard assessment, modeling, and monitoring of landslides (e.g., Jaboyedoff et al. 2012). In recent years, several US state agencies have considered the use of static (i.e., at a single epoch) lidar digital elevation models (DEMs) as well as change detections from repeat lidar scans for landslide inventory mapping.

One of the early lidar-based protocols for landslide inventory mapping was developed by the Oregon Department of Geology and Mineral Industries (DOGAMI) in cooperation with United States Geological Survey (USGS) (e.g., Burns and Madin 2009). Their methodology involved obtaining spatial and tabular data from a lidar-derived DEM at a single epoch, in combination with other data (e.g., previously mapped landslides, air photos), to identify and characterize landslides throughout Oregon. This protocol has also been adopted by the Washington Geological Survey (WGS 2023). Another study by DOGAMI (Burns et al. 2010) found that change detections from two lidar-derived DEMs (with 0.5 m pixel resolution, taken 3 months apart) during leaf-off (i.e., winter) and leaf-on (i.e., spring) conditions, was less useful for mapping landslides. The accuracy of change detections depended on the use of a detection threshold of 1 to 1.5 times the pixel resolution to remove noise, a spatial pattern recognition algorithm relating grouped detections to expected slope movement, and supplemental satellite imagery. The change detections were also affected by heavy vegetation in the leaf-on DEMs.

As indicated by the Burns et al. (2010) study, change detections using lidar can be interpreted using various approaches and algorithms, and can be prone to several uncertainties. A study by Mora et al. (2018) correctly identified 53 out of 80 inventory mapped landslides near Zanesville, Ohio using probabilistic vertical change detections and support vector machine (SVM) classifications of surface features based on airborne lidar-derived DEMs between 2008 and 2012. This study highlighted the need to consider uncertainty due to both the data source (e.g., lidar data acquisition) and the data preparation (e.g., interpolation of the DEMs). The different parametric choices made in the development of such an algorithm can also pose a bias relative to the type of landslide movement (e.g., rotational slides, translational slides, debris flows). More recently, a USGS study considered lidar change detections for mapping landslides before and after a major 2012 storm in northeast Minnesota (Delong 2022; full study is currently under review). This study used an object-based image analysis (OBIA) approach that combined the elevation changes with optical imagery and DEM-derived attributes (e.g., slope aspect, spatial extent) to delineate landslides. The North Dakota Geological Survey has also recently begun using lidar change detections coupled with geological interpretations for inventory updating (Maike 2023).

These studies indicate the general acceptance of lidar DEMs, and the growing use of lidar change detections, for improving landslide inventory mapping efforts. However, this past work also suggests that lidar change detections are influenced by errors and uncertainties, and need to be supplemented with additional data or interpretations. Finally, it should be noted that with improving spatial resolution, lidar offers better capabilities to detect smaller surface changes as well as better shape recognition.

2.4 Landslide Inventories from InSAR

InSAR has been widely used for the evaluation of landslides over the past two decades. InSAR encompasses a large variety of satellite image sources, and can be used for various landslide applications, including back-analysis of failures, characterization, input for modeling, inventory updating, mapping, and monitoring (Solari et al. 2020). Multiple satellite constellations from various space agencies are available, the most common of which use C-band (5.5 cm wavelength) or X-band (3.1 cm wavelength) data. The Sentinel-1 C-band satellite, with a ground sampling distance (GSD) resolution of about 5 to 20 m and 12-day data collection intervals, has become widely used due to its open-access availability. The Italian-based COSMO-SkyMed X-band satellite with a resolution of about 3 m has shown great improvements for landslide detection. Additionally, the NASA-ISRO Synthetic Aperture Radar (NISAR) L-band and S-band satellite, expected to launch in 2024, will provide open-access 3 to 10 m resolution data (e.g., Hlepas et al. 2023).

Multiple InSAR techniques have been deployed for various landslide activities, from event-driven landslides, such as those following the 2016 Kaikoura, New Zealand earthquakes (e.g., Jelenek and Kopackova 2021), to slow moving landslides and coastal subsidence processes, such as in the Calabria region of Italy (e.g., Cigna and Tapete 2021). Over 250 research papers regarding various InSAR techniques for landslide evaluations in Italy alone have been recently published, 15% of which are concerned with landslide inventory updating (Solari et al. 2020). Italy has become a testing ground for such work due to its high propensity for landslides, large

number of Italian-based InSAR providers and research centers, and other factors. One such work by Antonielli et al. (2019), the methodology of which is of greatest relevance to this current study, used A-DInSAR with both C-band (i.e., Envisat) and X-band (i.e., COSMO-SkyMed) data to suggest updates to the activity of 18 out of 26 inventoried landslides within the heavily forested Lombardy region. Their work also pointed to the ability of X-band data to retrieve over 10 times as many coherent persistent scatterer (PS) points relative to C-band data, and the importance of the satellite line of sight (LOS) relative to the slope orientation.

To the awareness of the authors, InSAR methods have not been adopted by US state agencies for landslide inventory purposes. Recent work by the Southern Methodist University and the USGS evaluated change detections between pairs of L-band InSAR images, coupled with optical imagery and high-resolution DEMs, to delineate 588 non-inventoried landslides along the US west coast (Xu et al. 2021). The datasets and processing techniques used by that study are greatly different than those used for this current study but serve a similar purpose. There is still no state-of-practice for the use of the InSAR for landslide inventory updating. As higher-resolution data becomes more widely accessible, the use of InSAR datasets for landslide inventories is expected to improve and become more well-accepted.

CHAPTER 3: DATA PROCESSING AND FINDINGS FROM LIDAR AND INSAR

3.1 General

A total of 99 landslide sites from the ODOT inventory were selected by ODOT for this work. These sites were geospatially processed using two remote sensing sources: (1) Light Detection and Ranging (lidar) and (2) Interferometric Synthetic Aperture Radar (InSAR). All 99 sites were evaluated by lidar, and a subset of 15 sites were evaluated with InSAR. Details about the distribution of selected landslide sites and data collected and processed from these two sources are discussed in this chapter.

3.2 Selected Landslide Sites for this Study

The landslide inventory data selected for this study comprises 99 sites in eastern Ohio from 6 different counties (i.e., Guernsey, Monroe, Jefferson, Noble, Belmont, and Harrison). Data pertaining to these sites has been documented following multiple field surveys over the past several years and added to ODOT landslide inventory (ODOT 2023a; more details in section 2.2). Figure 3.1 shows the selected 99 sites in eastern Ohio. These sites display a range of landslide types, Tier scores, remediation status, landslide extent (area, height, slope angle) and movements. A succinct description of the most pertinent landslide features is presented in this section to clarify the provided ODOT inventory data.

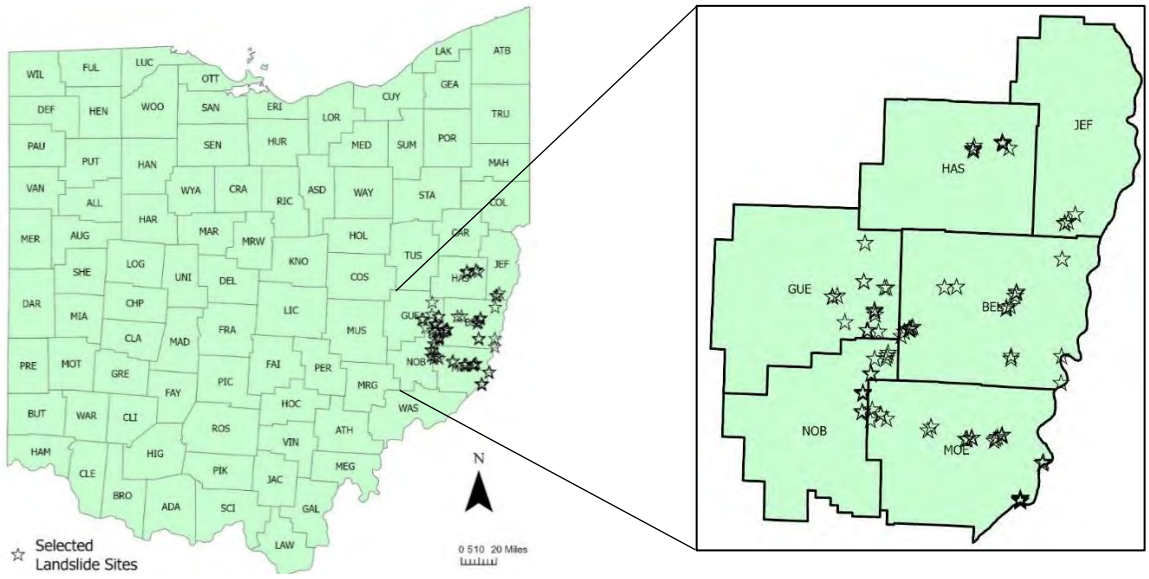


Figure 3.1. Selected landslide sites in eastern Ohio.

3.2.1 Tier Scores

The risk Tier classification in the ODOT inventory is determined from two probability scores accounting for: (1) the probability of additional movement of the slope (i.e., an occurrence score of 1 to 4), and (2) the probability of significant impact to an ODOT asset or adjacent property or

feature (i.e., an impact score of 1 to 4). These probability scores are index values based on observed landslide characteristics and professional judgement from field inspections. Higher probability scores denote a higher probability or susceptibility for that factor. These are combined into the overall Tier as described in Section 2.2. Figure 3.2 shows a bar chart depicting the overall Tier classification and probability scores for the 99 selected sites.

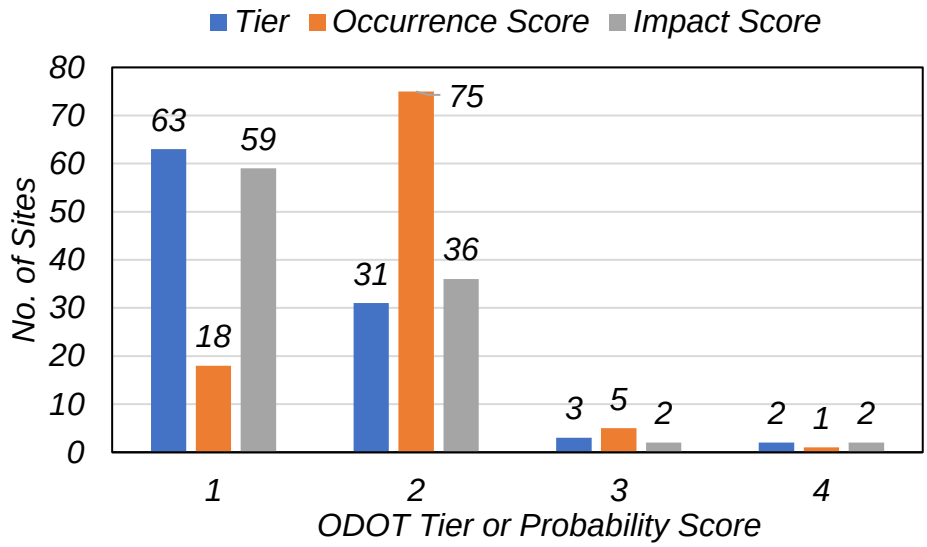


Figure 3.2. Distribution of Tiers and probability scores for the 99 selected sites.

3.2.2 Remediation

The distribution of remediated and non-remediated sites relative to the ODOT Tier is shown in Figure 3.3. Twenty-four of the study sites were remediated. Remediation measures (e.g., retaining walls, H-pile walls, rock blankets) were performed prior to the study period (Fall 2020) in most cases.

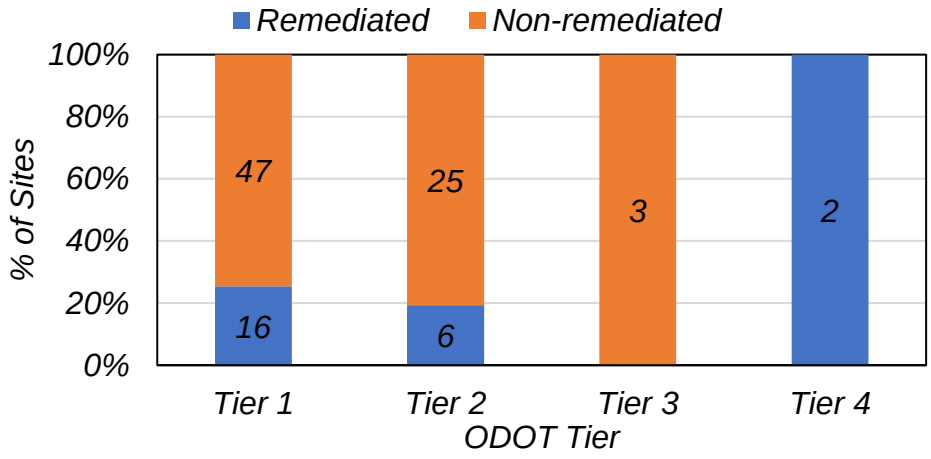


Figure 3.3. Distribution of Tiers and remediation status (Note: the numbers on bars represent the total landslide count).

3.2.3 Landslide Type

Out of 99 sites only 38 sites have details about the type of landslide movement (i.e., this was typically not recorded for Tier 1 sites). Figure 3.4 shows the distribution of landslide type compared to the ODOT Tier. Only sites above Tier 1 include landslide movement information with few exceptions. The majority of landslides in the dataset are caused by rotational movements.

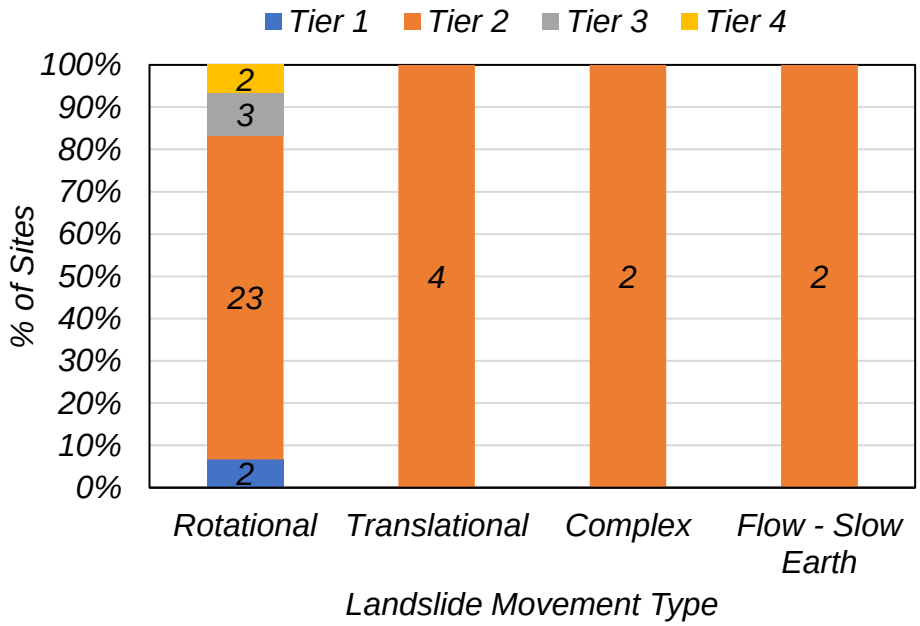


Figure 3.4. Distribution of landslide movement type for the 99 selected sites (Note: the numbers on bars represent the total landslide count).

3.2.4 Landslide Extent

The landslide extent is presented in terms of slope height, slope angle, area, and depth of landslide. Area of the landslide is not explicitly available in the inventory data. It is herein estimated as the product of the available hazard area length and width and is hence termed as an "approximate" landslide area. Figures 3.5, 3.6, 3.7, and 3.8 show the frequency distributions of average slope angle, estimated slope height, approximate landslide area, and depth of sliding surface.

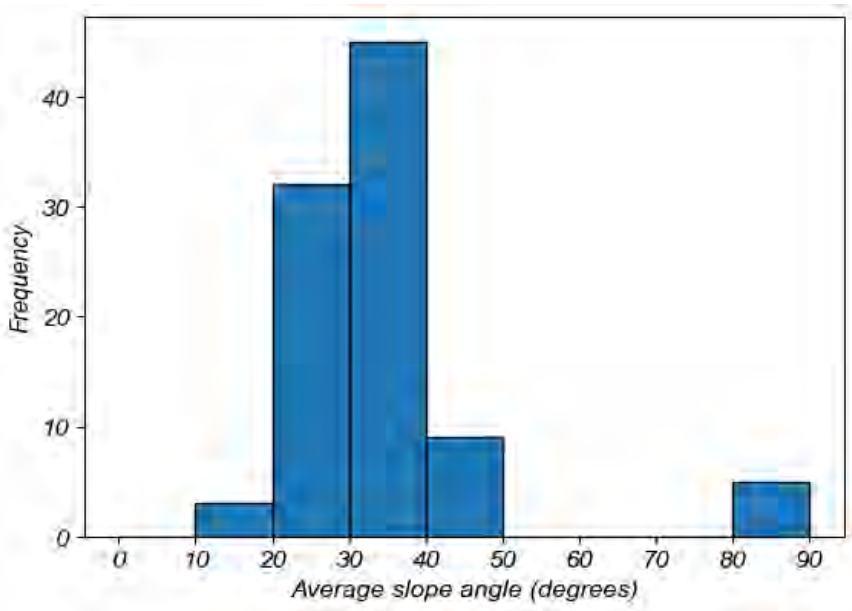


Figure 3.5. Frequency distribution for average slope angle for the 99 selected sites.

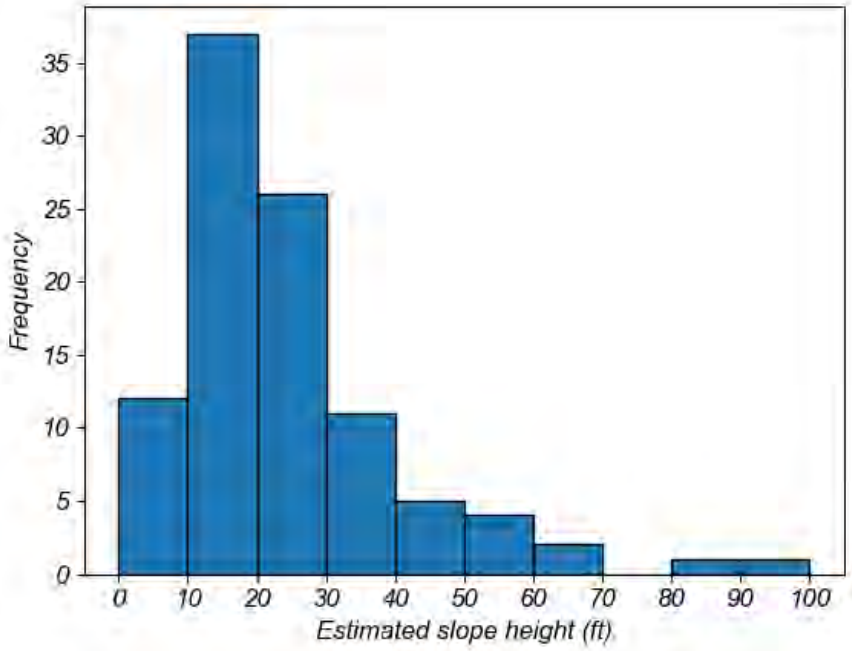


Figure 3.6. Frequency distribution for estimated slope height for the 99 selected sites.

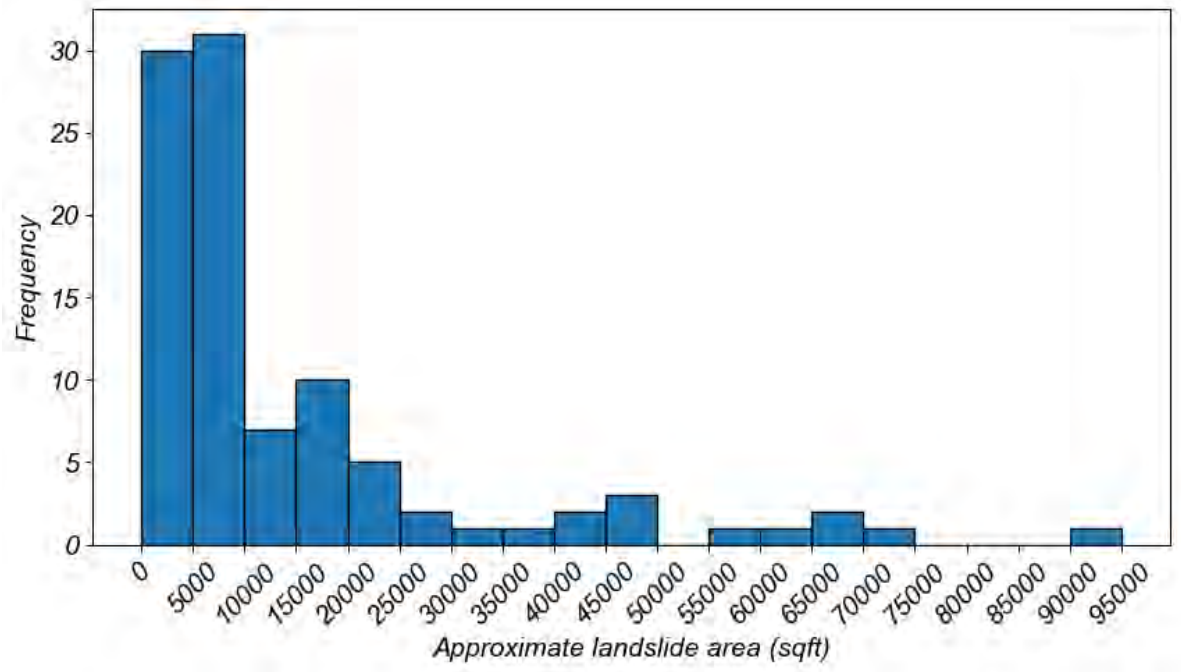


Figure 3.7. Frequency distribution for approximate landslide area for the 99 selected sites.

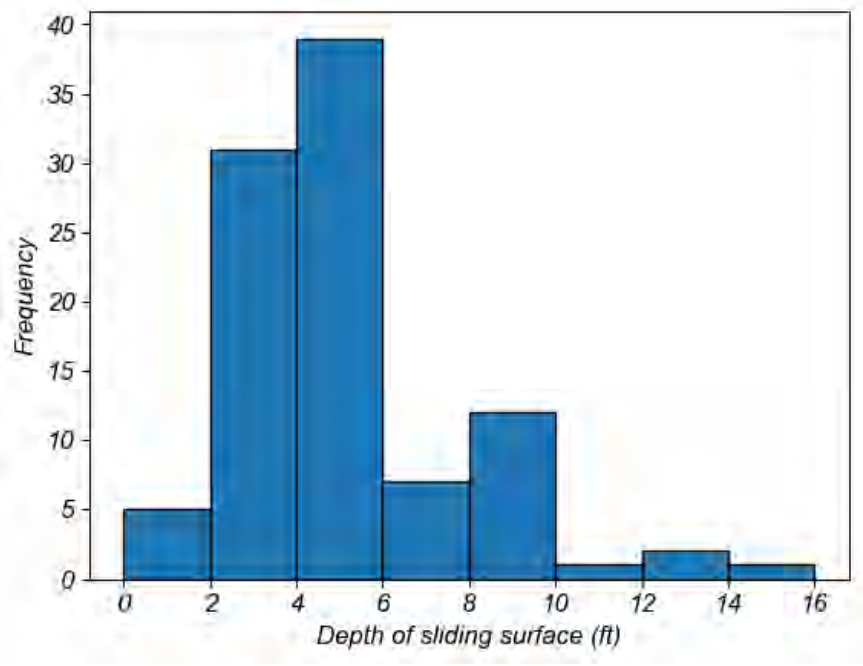


Figure 3.8. Frequency distribution for depth of sliding surface for the 99 selected sites.

3.3 Lidar Evaluation

3.3.1 Data availability and processing

Geospatial data and analytics provider Teren Inc. was retained to complete a lidar evaluation of the study area, encompassing all 99 landslide sites. Teren provides airborne lidar data for four regions in the U.S. Their Appalachia coverage area includes (in entirety or in part) the six Ohio counties containing the 99 landslide sites of this study. The data is collected at a ground sampling distance (GSD) resolution of 40 cm with a potential for a lidar point density of 20 points per meter (PPM) in some areas. Teren collected LiDAR data during two seasons: (1) Fall of 2020 and (2) Spring of 2023 for change detection analysis. Initially change detection was to be carried out between Spring 2020 and Spring 2023, however data collected during Spring 2020 was less than ideal due to heavy vegetation that affected the spatial resolution and data accuracy. Fall 2020 data is considered as "Time 1," and Spring 2023 is considered as "Time 2" herein.

Data provided by Teren includes two main outputs: (i) the "geohazard polygon" detection and ranking system as obtained from lidar scans at a single epoch (i.e., one instance of time), and (ii) the "change detection polygons" obtained from the comparison of two epochs. A detailed account of these outputs is discussed in the following sections.

3.3.1.1 Geohazard polygons

These polygon features represent detected landslide sites from Teren's lidar evaluations. A computer vison algorithm is used for detecting and delineating each landslide's structural features, such as scarp and toe slope. Once the polygons were detected by lidar evaluations, a geohazard assessment was used to identify the associated geohazard risk. The area of interest for geohazard identification was set by Teren at 984 ft (300 m) around each ODOT landslide site. For this geohazard assessment, each geohazard polygon is assigned a relative ranking score to indicate the threat to nearby structures. The geohazard assessment was originally devised for pipeline applications but is applied to the roadside landslides for this project. The product overview provided by Teren further describes this process (see Appendix C).

The geohazard ranking system used by Teren is based on a predefined decision tree which considers different variables considering the geohazard and its influence to a nearby structure. Figure 3.9 shows the sequential order of these variables for pipeline applications. In this decision tree, each variable has a threshold for moving from one node of the tree to the other. The process continues until a risk-based ranking can be assigned for the geohazard. For the decision tree in Figure 3.9, Teren switched the pipeline centerline to the road centerline for the landslide applications of this study; however, the centerline may not be the best representation of the roadway.

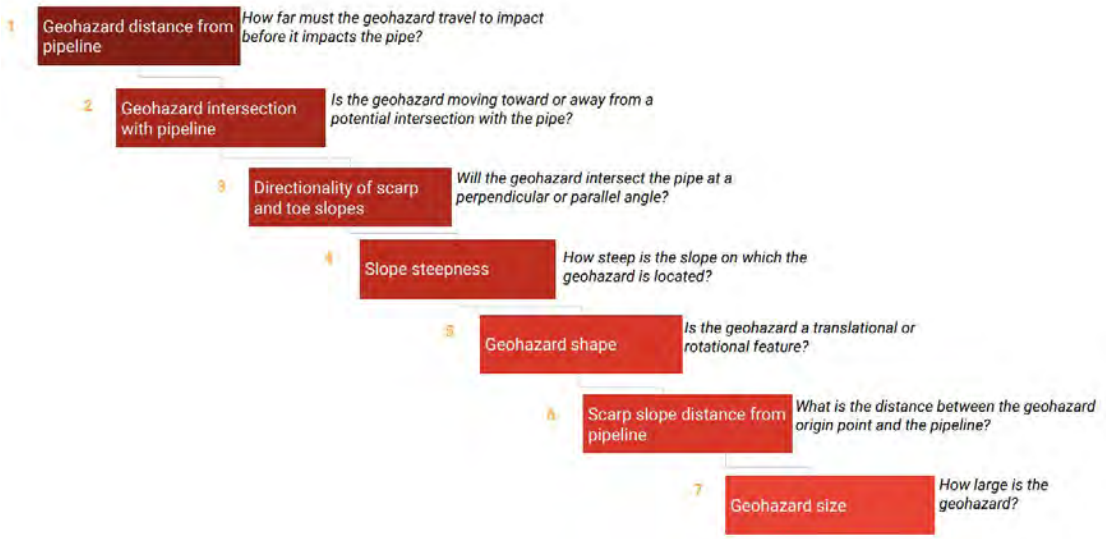


Figure 3.9. Decision tree for Teren's geohazard assessment ranking system, as developed for pipeline applications.

Data provided for the geohazard polygons includes shapefiles containing polygon features for detected landslides by lidar evaluations of the Fall 2020 and the Spring 2023 data. The geohazard ranking is included within the attribute table of the geohazard polygons. Teren also provides an interactive online viewer to visualize and analyze the data. Figure 3.10 is a screenshot of the online viewer, depicting the extent of the dataset and a list of the provided layers. Note that the viewer comes with limited functionality in terms of data analysis and manipulation capabilities. Figure 3.11 shows an example of a detected geohazard polygon near an ODOT landslide site.

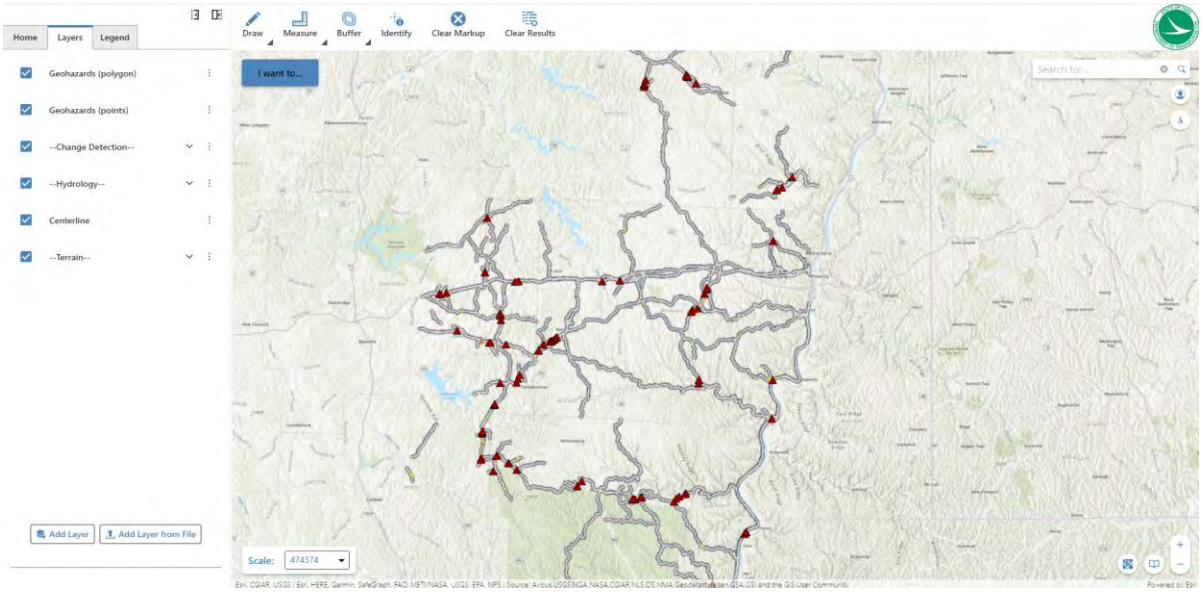


Figure 3.10. Example screenshot of Teren online viewer.

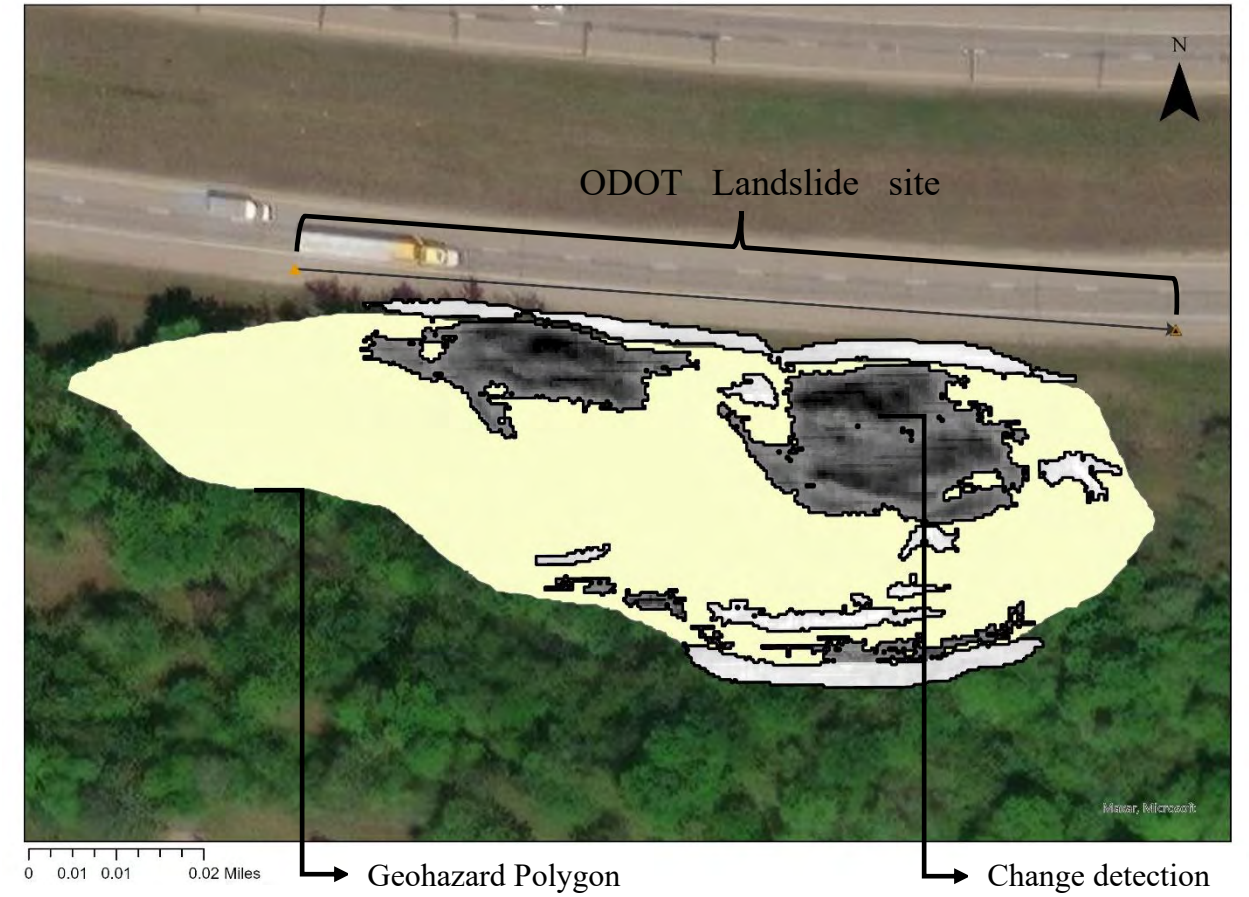


Figure 3.11. Example geohazard polygon with multiple change detection polygons (LS00006904).

3.3.1.2 Change detection polygons

The change detection polygons are geospatial features that indicate the vertical surface changes in the terrain that occur over a time interval. Teren compares the landscape topography from digital terrain models (DTMs) obtained at two different times to detect subtle structural changes. An algorithm is first used to remove vegetation artifacts and perform a range-based elevation correction. Vertical change differences greater than a 1 ft threshold are then obtained within 60 ft from the structural asset centerline. The 1 ft threshold was set by Teren to minimize potential errors; this can be lowered to allow the detection of more polygons with smaller movements. The resulting change detections are presented as polygons with a raster heatmap representing the magnitude of vertical changes over two time periods (i.e., Fall 2020 and Spring 2023 herein). Figure 3.11 shows an example of changes detected within the geohazard polygon. There are a total of 14 change detection polygons in Figure 3.11 (filled with darker grays to indicate larger positive movements and lighter grays to indicate larger negative movements). Vector-format polygon features are also provided for the perimeter of the change detections.

Teren provides edited and unedited change detection data for the specified time period. About 98% of the original changes detected by Teren's analysis were filtered out as false positives. The filtering process first removes systematic or linear trends, then uses an algorithm to detect interpolated artifacts due to vegetation, standing water, and other features (A. Savage, personal communications).

3.3.2 Results: geohazard polygons

The lidar-based evaluation by Teren detected 160 geohazard polygons (i.e., representing landslides) near the ODOT landslide sites. The provided polygon shapefiles include an attribute table with parameters for various characteristics of the detected polygons. The most pertinent parameters of the attribute table can be broadly categorized into three groups: (1) acquisition details, including date, location coordinates, and other identification parameters, such as slip ID, (2) geohazard details which include information about the scarp and toe slope height, direction, and distance from centerline, average slope angle, volume of the slide, impact angle, and (3) geohazard assessment ranking of the polygons. Estimated hydrological details are also available, but not considered herein. A more detailed account of all these parameters can be found in the Data Handoff document and Data Dictionary provided by Teren, and included in Appendix C. Appendix C also includes the full attribute table for geohazard polygons.

Teren's geohazard assessment ranking ranges from 1-10, where 1 represents the least risk and 10 the highest. The ranking for the 160 detected geohazard polygons ranges from 1-9. The distribution of these rankings is plotted in figure 3.12. It is observed that most of the polygons are ranked as 5 or less, and only 6 (~4%) of the polygons are ranked greater than 5.

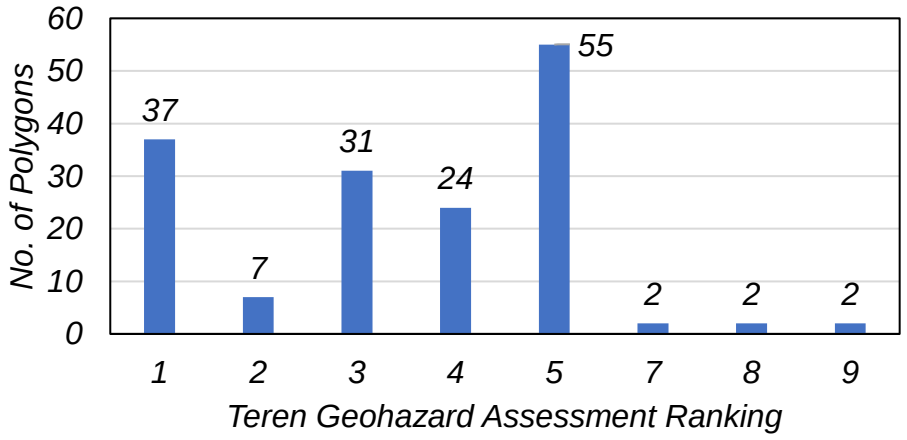


Figure 3.12. Distribution of Teren geohazard assessment ranking for 160 landslides detected from the geohazard polygons.

3.3.3 Results: change detection polygons

The lidar-based evaluation and filtering by Teren produced 64 change detection polygons and their respective raster movements. These change detections are concentrated within 21 out of the 160 geohazard polygons. Vertical movements greater than 1 ft are reported with the largest

movement reaching ~9 ft. The attribute table provided by Teren also reports the change detection area, the minimum and maximum movements, and the estimated volume of the moving soil mass, among other details. Appendix C presents the full attribute table for change detection polygons. Figure 3.13 shows the distribution of the Teren geohazard assessment ranking for the 21 geohazard polygons with change detection polygons. It is observed that only one such polygon has a ranking of greater than 5. Appendix C includes the attribute table for change detection polygons.

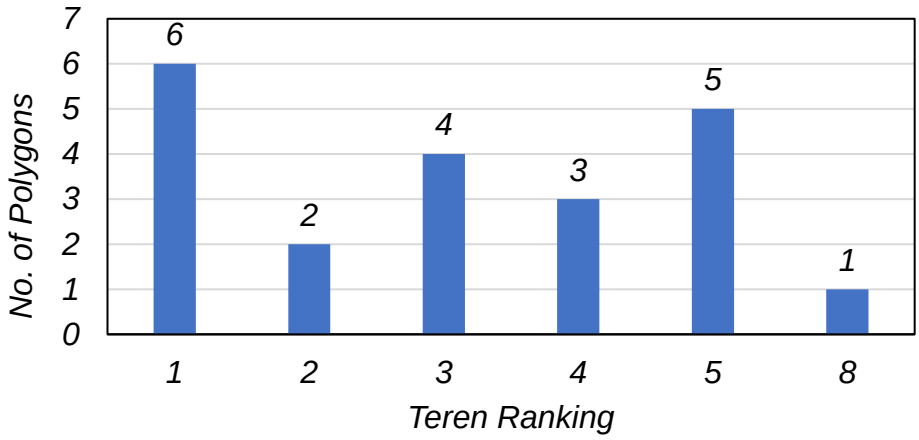


Figure 3.13 Distribution of Teren geohazard assessment ranking for the 21 geohazard polygons with change detection polygons.

3.4 InSAR Evaluation

3.4.1 Data availability and processing

Radar-based satellite data analytics and software provider EO59 was retained to complete an InSAR data evaluation for selected regions of the study area. EO59 processed InSAR data collected by the Sentinel-1 satellite for time series change detections. Sentinel-1 is the satellite mission of the European Space Agency (ESA), and its data products are publicly available free of cost. The Sentinel-1 captures radar data over the globe once every 12 days for each orbital direction. Only the ascending orbit is available for the eastern Ohio study area. Data at four regions in Jefferson and Monroe County was collected and processed for the time inverval between May 2016 to April 2023. Figure 3.14 shows the footprint of data collection covering the area of interest.

EO59 uses an Advanced Differential InSAR (A-DInSAR) methodology for processing radar data to obtain ground surface change detections. A-DInSAR is a radar-based method in which radar reflections from the Earth's surface are recorded and processed to estimate ground deformation time series. One popular A-DInSAR based technique is Persistent Scatterer Interferometry (PSI) which has wide applications in landslide monitoring. PSI uses a large sequence of synthetic aperture radar (SAR) images to measure subtle ground deformation at a millimeter level of accuracy along the satellite Line of Sight (LOS). PSI along with conventional topographic data can be used for updating landslide inventories. However, PSI relies on the monitoring of Persistent Scatterers (PS) point targets that remain coherent over a long period of time (e.g., buildings, bridges, railways, outcropping rocks). Over a highly vegetated area, the availability of PSs is reduced, which can affect interpretations of the extent and certainty of movement.

EO59 typically performs linear regressions on the PSI times series data to provide cumulative displacements and average velocities over the time interval of interest at each PS point. Following communications with EO59, our research team accordingly reduced the overall time series interval of May 2016 to April 2023 to match the lidar acquisition period of Fall 2020 to Spring 2023. This required re-calibrating the linear regressions and updating the cumulative displacements and average velocities.

The data provided by EO59 includes GEOJSON files for the InSAR captured data points and CSV files for time series data. They also provided an interactive online viewer to visually analyze the data (see example screenshot in Figure 3.15). The online viewer provides PS point locations color-coded for the extent of deformation. Selecting the PS points provides PS displacement time histories for time intervals of interest.

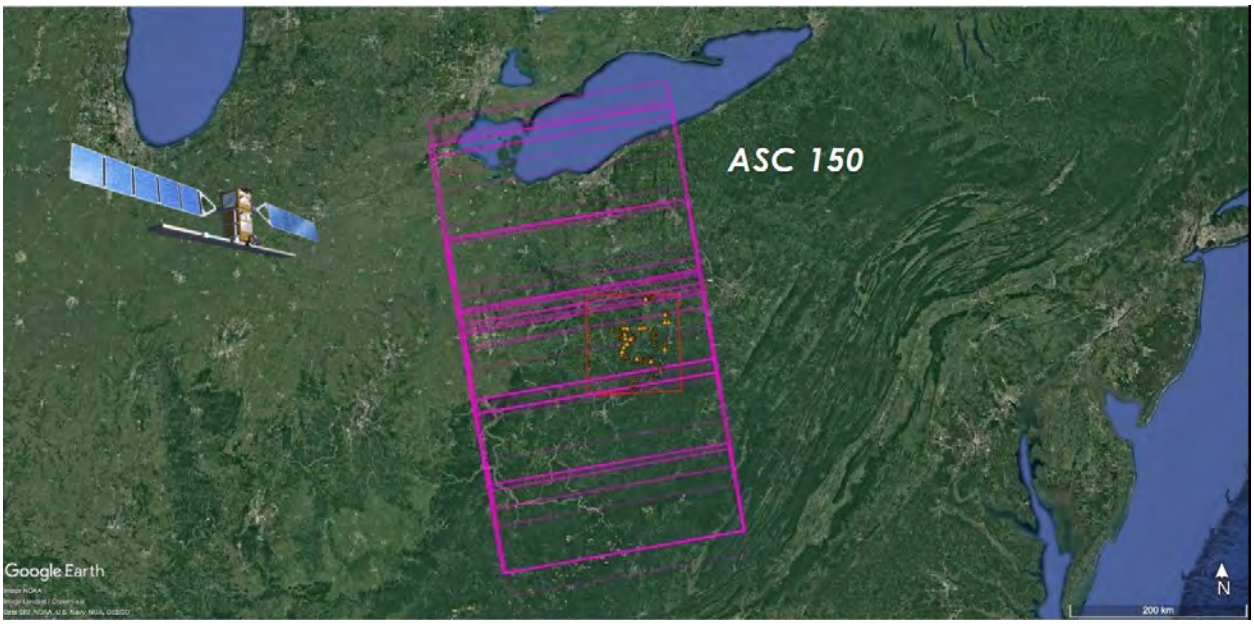


Figure 3.14. Footprint of ascending Sentinel-1 data collection for area of interest.

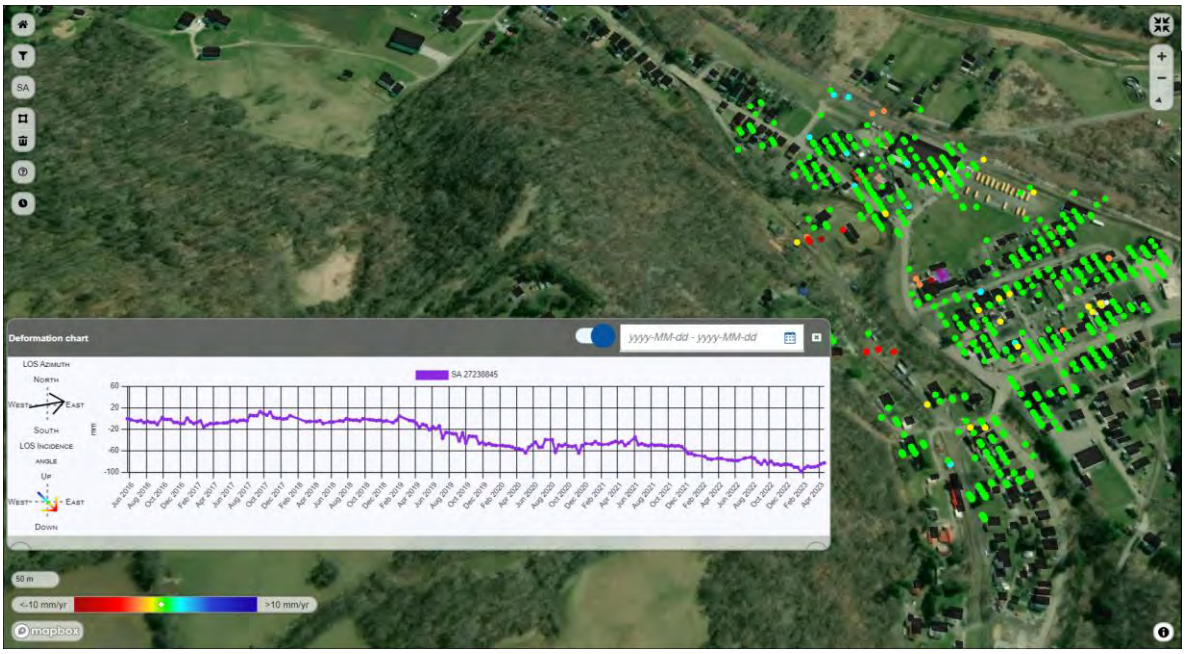


Figure 3.15. Example screenshot of EO59 online viewer.

3.4.2 Results: Persistent Scatterers

The methodology discussed in section 3.4.1 was used to process A-DInSAR data for four specified regions: (1) along SR150 in Jefferson County, (2) along SR7 in Monroe County, (3) along SR78 East in Monroe County, and (4) along SR78 West in Monroe County. The number of PS points detected for each study region is shown in Table 3.1. Figures 3.16-3.19 show InSAR

detected PS data points for each of four study regions. Note that the indicated colors represent movements during the full May 2016 to April 2023 monitored period. Appendix D includes supplementary data regarding EO59 data processing.

Table 3.1. Number of PS points in each study region.

Study region	PS points
Jefferson SR150	891
Monroe East SR78	76
Monroe West SR78	92
Monroe SR7	914

Figure 3.16. PSs detected in the Jefferson SR150 study area.

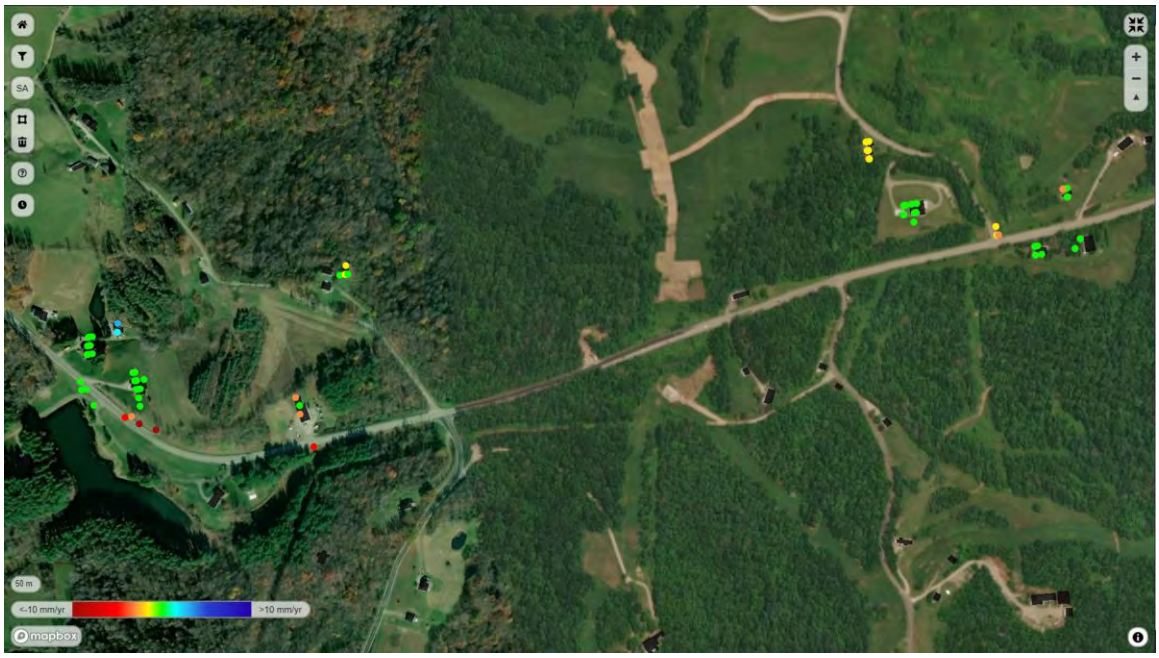


Figure 3.17. PSs detected in the Monroe SR 78 East study area.

Figure 3.18. PSs detected in the Monroe SR 78 West study area.

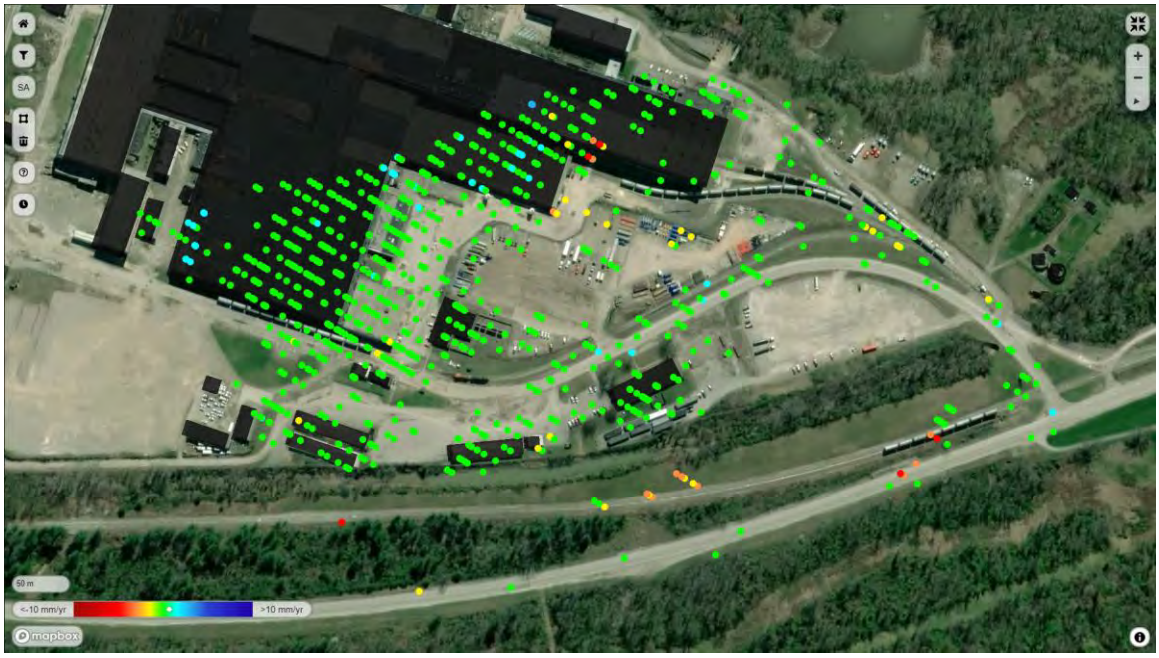


Figure 3.19. PSs detected in the Monroe SR 7 study area.

CHAPTER 4: COMPARISON OF REMOTE SENSING DETECTIONS WITH LANDSLIDE INVENTORY

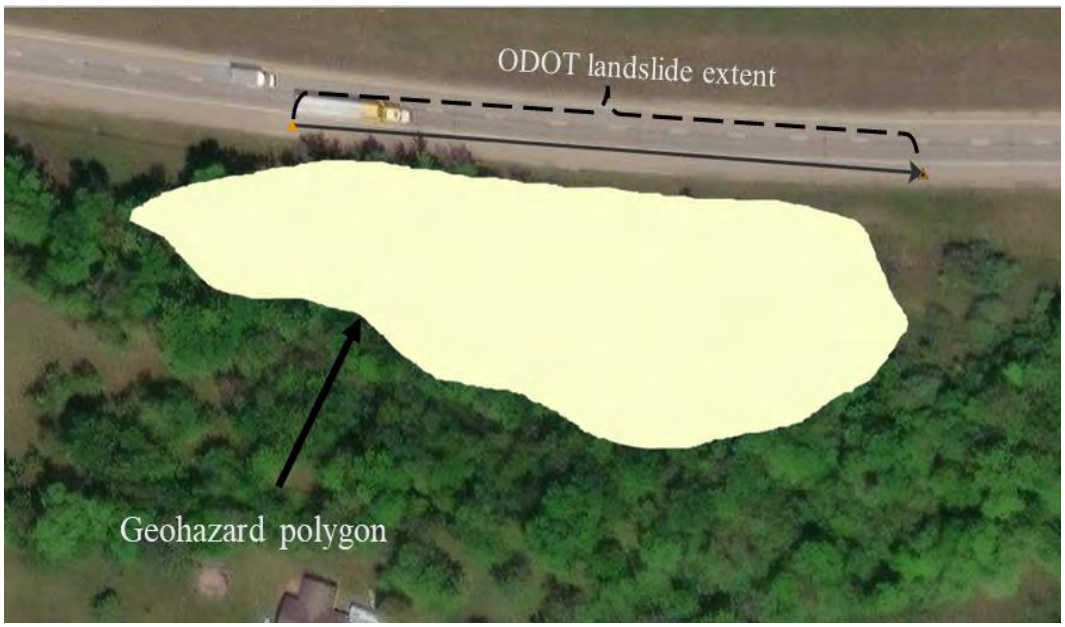
4.1 General Comparisons

Our research team conducted comparisons for assessing the effectiveness of lidar and InSAR in detecting the selected sites from the ODOT landslide inventory. In these comparisons, ODOT data serves as a baseline, and any deviations are reported here. These comparisons primarily address two key questions: (1) Does remote sensing adequately detect the presence of landslides?; and (2) How do the predicted metrics from remote sensing compare to the data recorded in the ODOT inventory? The "metrics" suggested by question 2 include qualitative categories (e.g., extent of coverage, rankings) and quantitative variables (e.g., amount of movement).

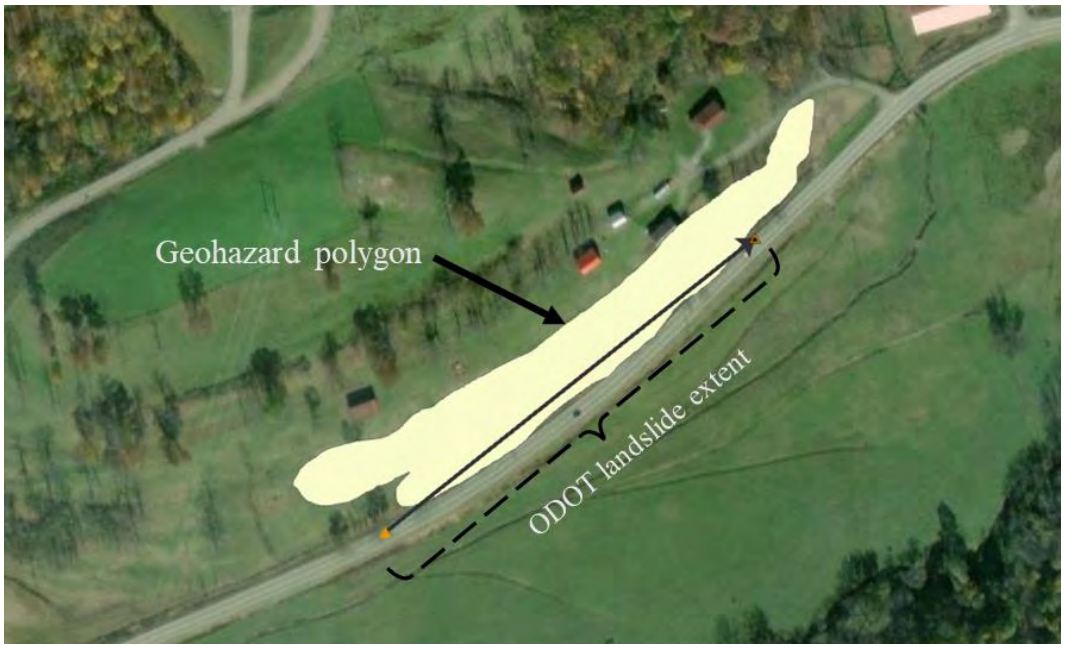
4.1.1 Lidar geohazard polygons

The lidar-derived geohazard polygons represent the area or extent of detected landslides. To compare these polygons with the 99 selected ODOT landslide sites, a coverage category framework was established. These categories indicate how closely the geohazard polygons align with the provided beginning and ending mileposts (e.g., BMP and EMP) of the ODOT landslides.

Five coverage categories are defined based on how well these polygons match the ODOT inventoried extent: (1) Full coverage (FC): the geohazard polygon(s) encompasses the full inventoried extent and may extend beyond it. Figure 4.1 presents examples of FC sites. (2) More than half coverage (MH): the geohazard polygon(s) covers more than half of the inventoried extent. Figure 4.2 presents examples of MH sites. In Figure 4.2(a), two geohazard polygons together cover more than half of the inventoried extent. (3) Less than half coverage (LH): the geohazard polygon covers less than half of the inventoried extent. Figure 4.3 presents examples of different LH coverage scenarios. (4) Not in extent (NE): the geohazard polygon is detected near but is not within the inventoried extent. Any polygon detected on the opposite side of the road also falls into this category. Determining the cardinal direction and relative location of the ODOT landslides in relation to the roadway per the ODOT (2023) was crucial for this comparison. Figure 4.4 presents examples of NE sites. (5) Not detected (ND): no geohazard polygon is detected near the inventoried extent (i.e., lidar did not capture this site). Figure 4.5 presents examples of ND sites.

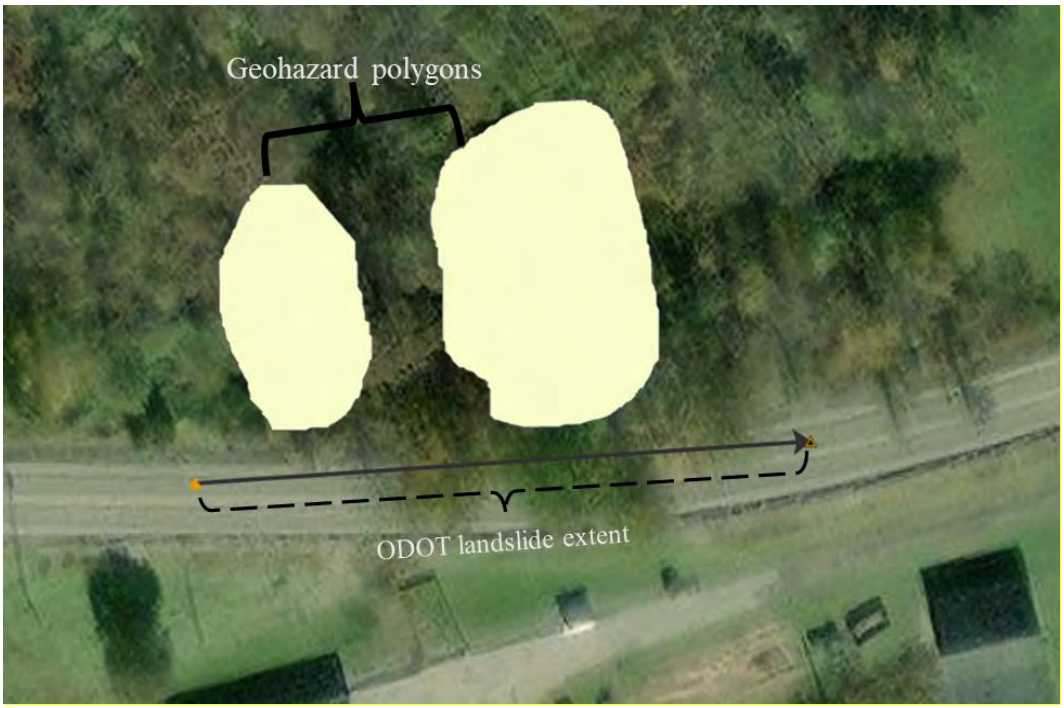


(a)

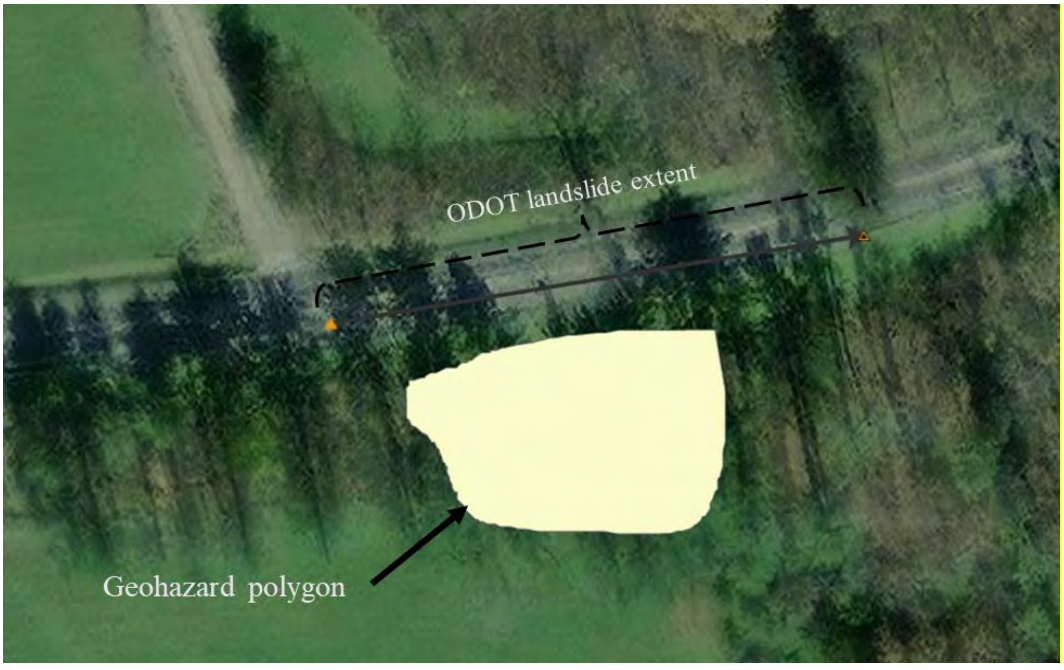


(b)

Figure 4.1. Examples of "full coverage" (FC) sites: (a) LS00006904 and (b) LS00002254.



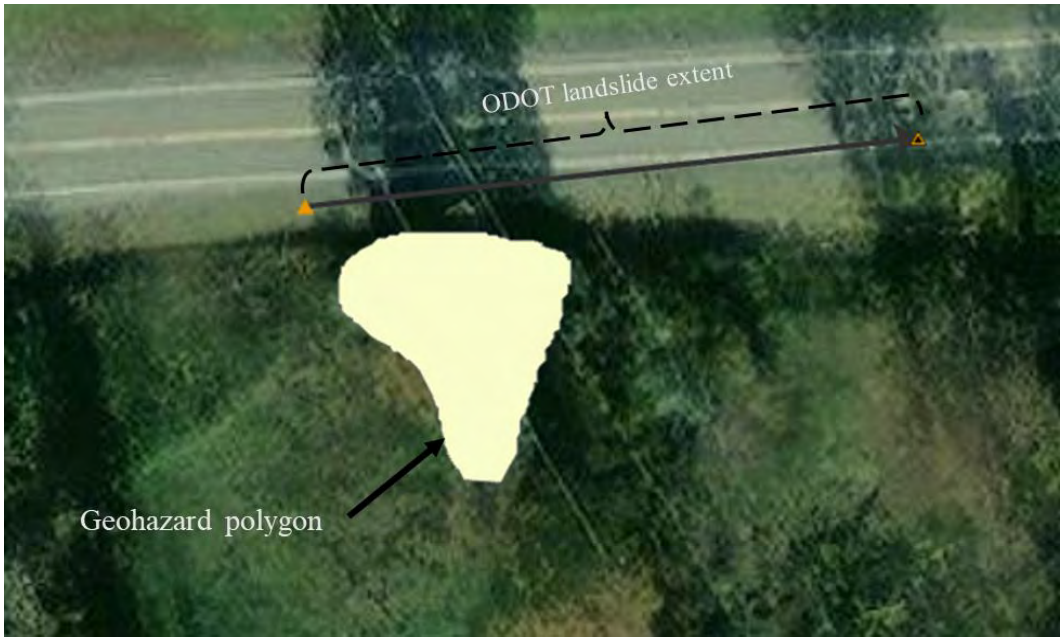
(a)



(b)

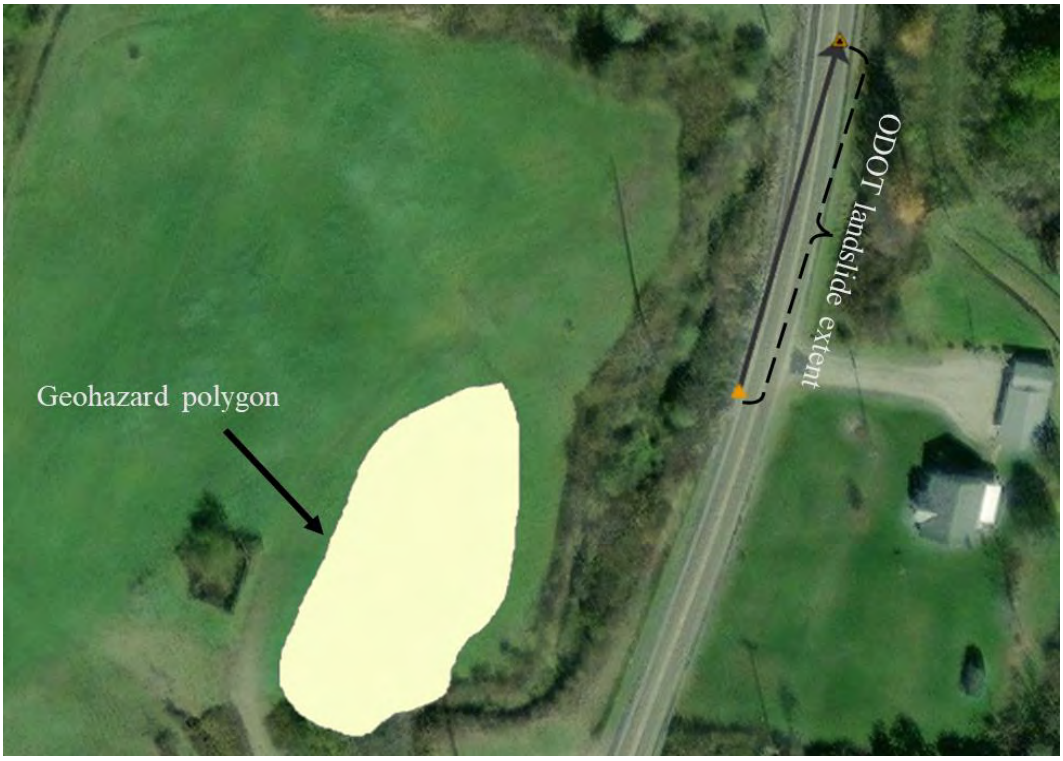
Figure 4.2. Examples of "more than half" (MH) coverage sites: (a) LS00007054 and (b) LS00006360.

(a)

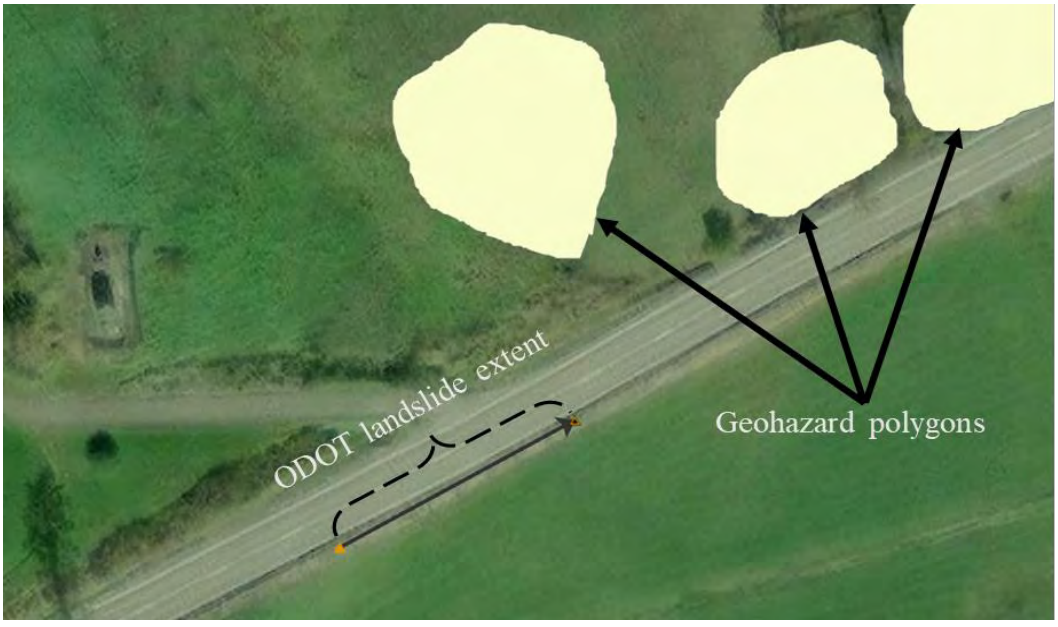


(b)

Figure 4.3. Examples of "less than half" (LH) coverage sites: (a) LS00008277 (b) LS00001907.



(a)



(b)

Figure 4.4. Examples of "not in extent" (NE) sites.

(a)

(b)

Figure 4.5. Examples of sites not detected (ND) by lidar.

All 99 selected ODOT sites were categorized using the coverage framework. The distribution of coverage categories among ODOT sites is shown in Figure 4.6. The lidar evaluation is able to cover or detect approximately 60% of ODOT sites within the extent, with 39 of these sites being fully covered (i.e., FC). About 23% of the sites show nearby polygons outside the inventoried extents, and 17% of the sites are not detected by lidar (i.e., ND).

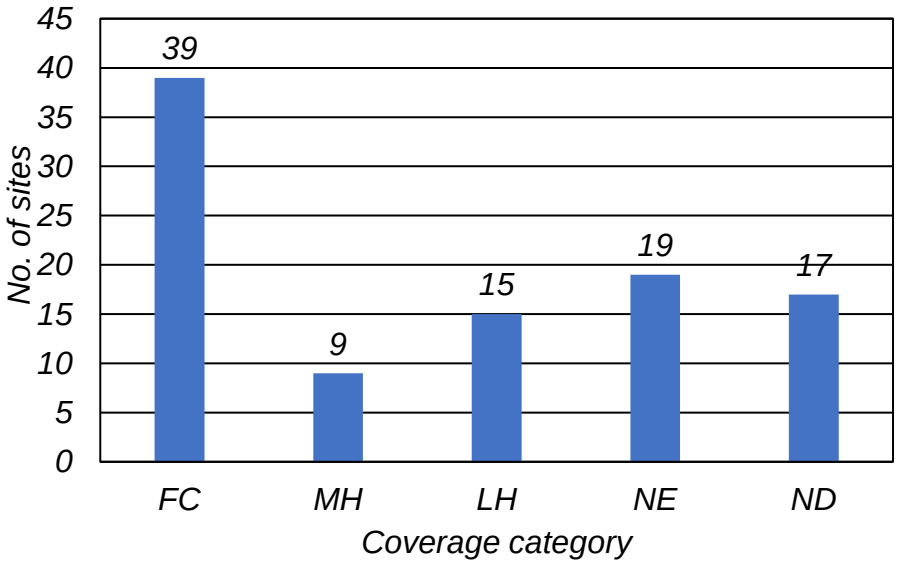


Figure 4.6. Distribution of coverage categories among the 99 selected ODOT sites.

The distribution frequency of coverage categories is considered for each ODOT Tier in Figure 4.7. Tier 1 and 2 sites captured all five coverage categories with somewhat consistent percentages of sites in each category between both Tiers. Between 35-40% of both Tier 1 and Tier 2 were either NE or ND. One out of the five Tier 3-4 sites was NE, and one was ND. Figure 4.8 presents the distribution frequency of coverage categories relative to landslide impact probability scores determined by ODOT. The trends closely mirror those observed in the Tier comparison. Figure 4.9 shows the distribution frequency of coverage categories relative to landslide occurrence probability scores determined by ODOT. It is interesting to note that 61% of occurrence score 1 sites, and 32% of occurrence score 2-4 sites are either NE or ND. This difference in percentages suggests that lidar is more likely to detect sites that show greater evidence of occurrence in the field surveys.

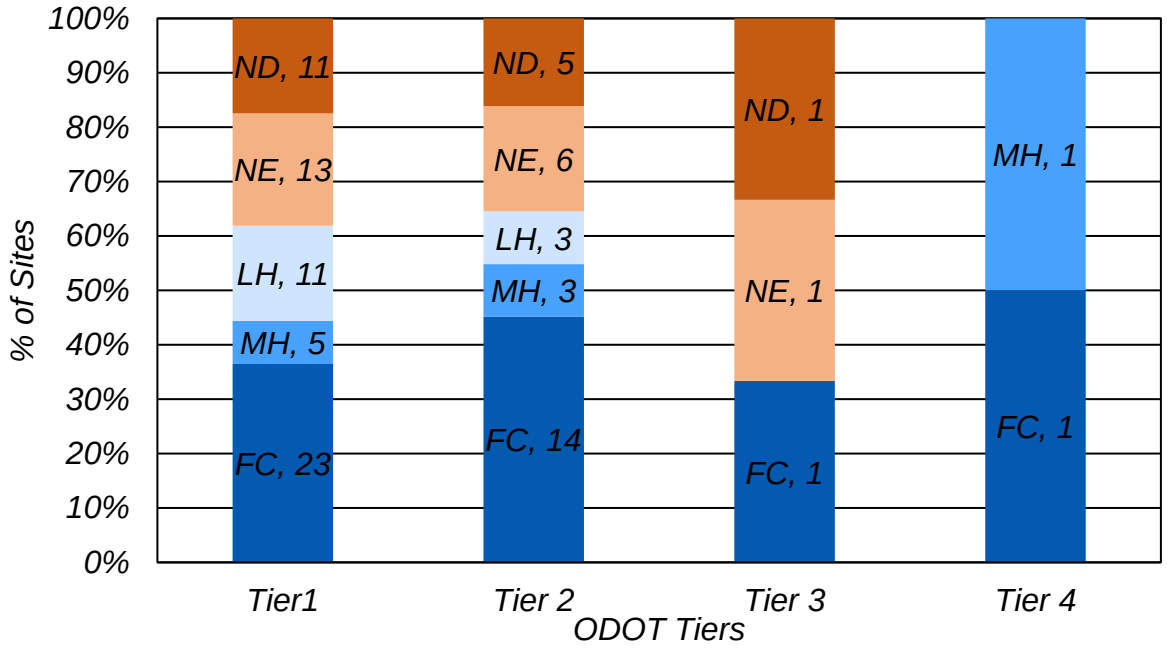


Figure 4.7. Distribution frequency of coverage categories with ODOT Tiers for the 99 selected sites.

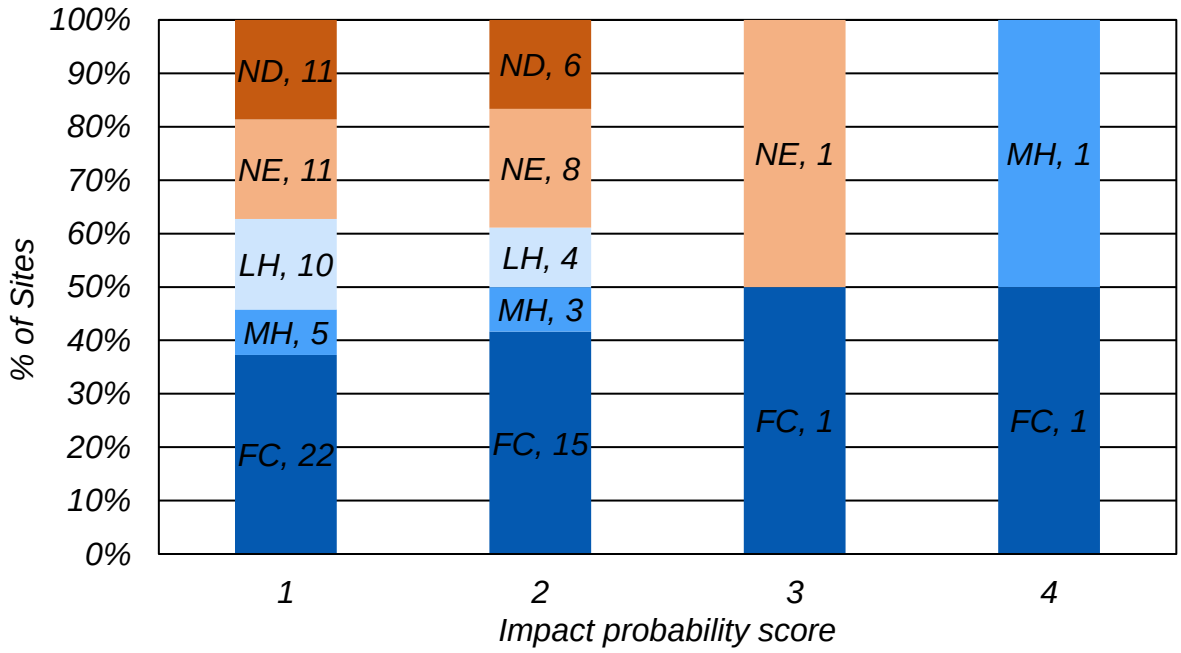


Figure 4.8. Distribution frequency of coverage categories with ODOT impact score for the 99 selected sites.

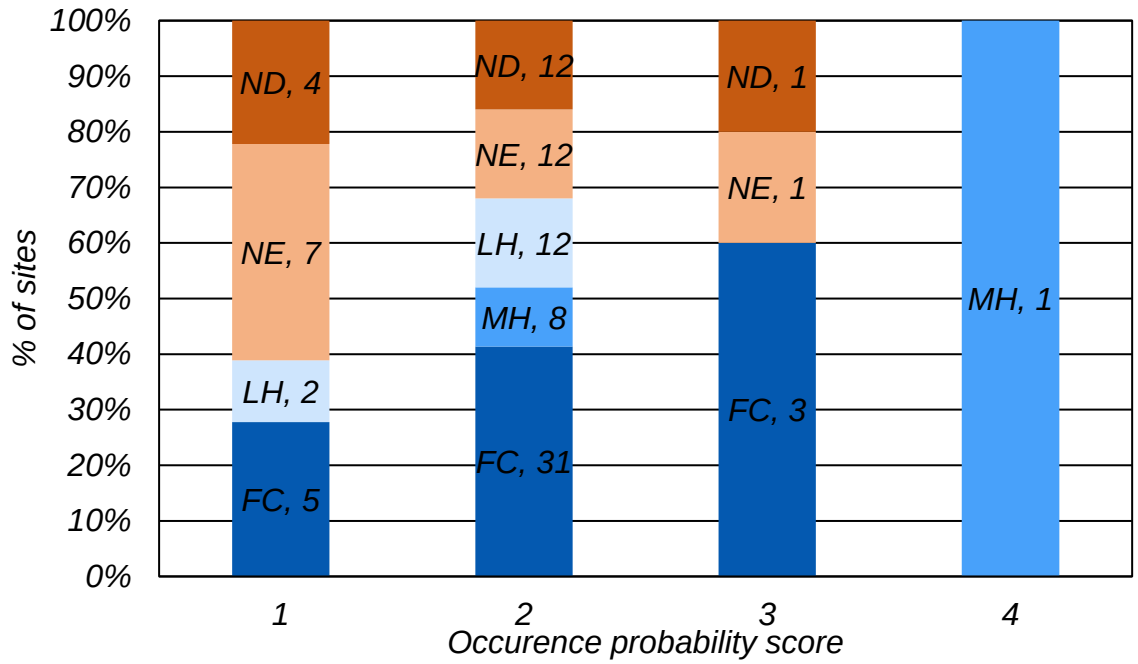


Figure 4.9. Distribution frequency of coverage categories with ODOT occurrence score for the 99 selected sites.

Out of the 160 lidar-derived geohazard polygons, 65 were found within the ODOT inventoried landslide extents. Three ODOT sites encompassed multiple polygons, as exemplified in Figure 4.2a, such that these 65 polygons are captured by the 62 ODOT sites categorized as either FC, MH, or LH. Figure 4.10 presents the distribution of ODOT occurrence score, impact score, and Tiers for these 65 geohazard polygons. Figure 4.11 presents the distribution of Teren's geohazard assessment ranking for these 65 polygons. Notably, this distribution closely mirrors the trends observed in Figure 3.11, with 98% of the polygons falling within rankings 1-5. Figure 4.12 and Table 4.1 provides the frequency distributions of between ODOT Tiers and the Teren ranking. Interestingly, two polygons associated with ODOT Tier 4 correspond to a Teren ranking of 5, while the three polygons with higher Teren rankings of 7-9 align with ODOT Tiers 1 and 2. This suggests a discrepancy between the ODOT Tiers and the Teren ranking, as expected due to the different methodologies and attributes considered. Also, the lidar data may be affected by several uncertainties in the determination of geohazard polygons, and the ODOT Tiers may be affected by subjectivity due to engineering judgement used for Tier determination.

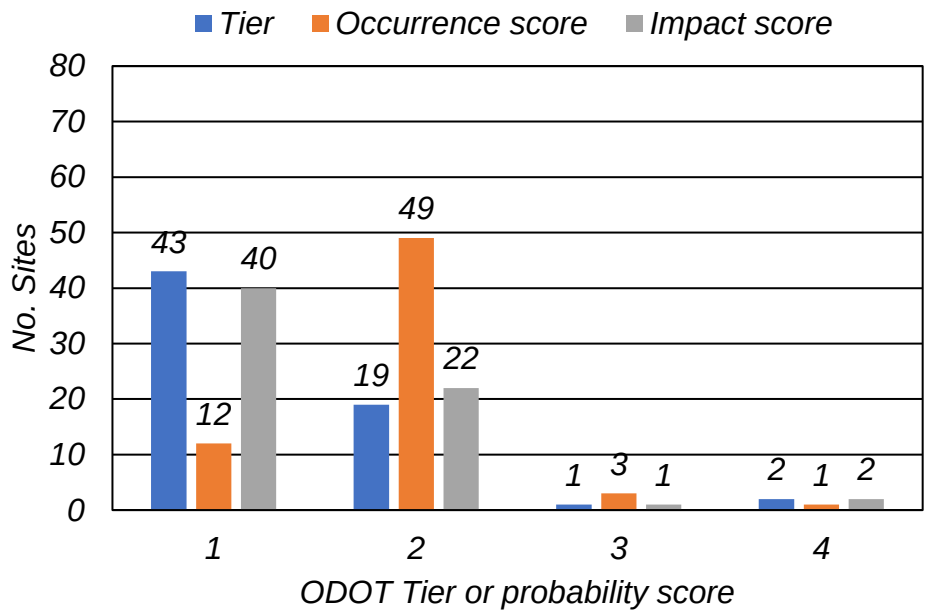


Figure 4.10. Distribution of ODOT tier scores for 65 polygons.

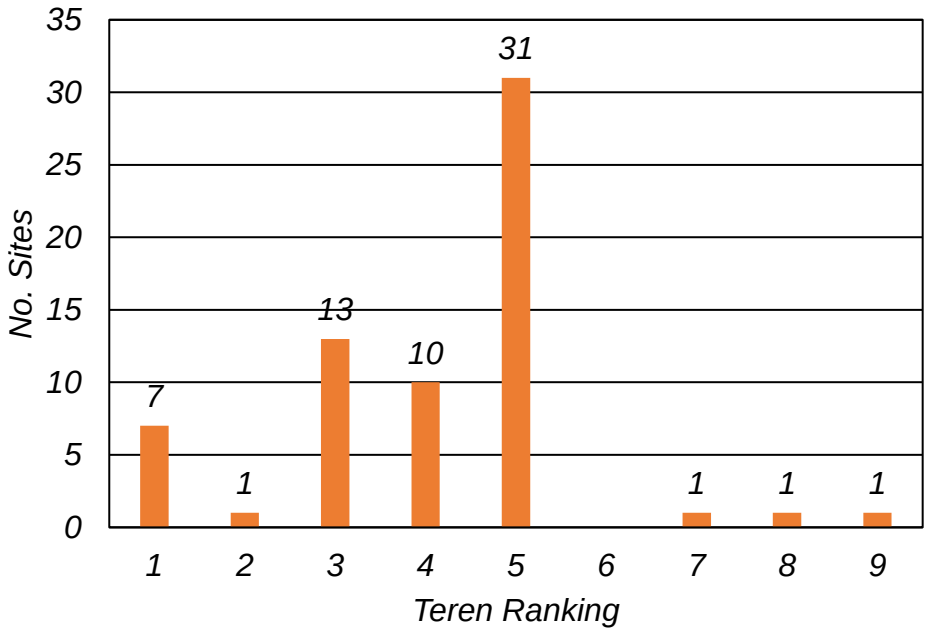
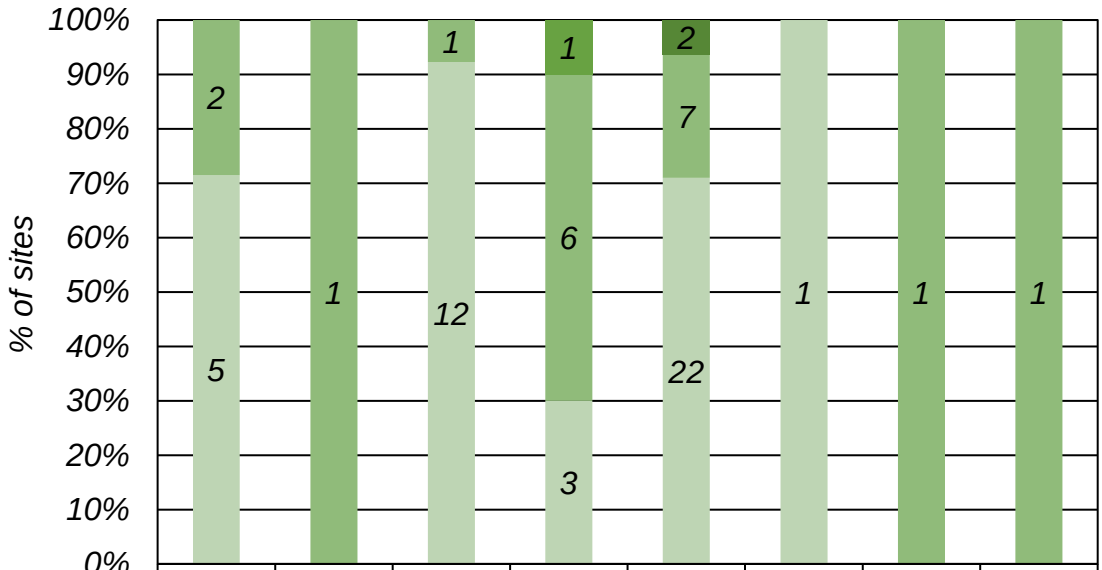


Figure 4.11 Teren ranking distribution for 65 polygons.



Teren ranking:	1	2	3	4	5	7	8	9
Tier 4	0	0	0	0	2	0	0	0
Tier 3	0	0	0	1	0	0	0	0
Tier 2	2	1	1	6	7	0	1	1
Tier 1	5	0	12	3	22	1	0	0

Figure 4.12 ODOT Tier and Teren Ranking comparison.

4.1.2 Lidar change detection polygons

Among the 64 change detection polygons, 39 are identified within the 99 selected ODOT landslide sites. However, several inventoried landslides span multiple change detection polygons within their boundaries as depicted in Figure 3.11, such that the 39 change detection polygons are distributed across only 12 ODOT sites.

Table 4.1 depicts change detection metrics for 12 ODOT sites, along with the ODOT Tier, Teren ranking, and horizontal crack and vertical dip measurements of the road. Of the 12 sites captured 7 (58%) had an ODOT risk Tier of greater than 1. However, only 35 of the 99 considered sites (35%) had an ODOT risk Tier of greater than 1. As expected, the lidar change detections were more likely to capture sites with a higher risk Tier.

The change detection metrics in Table 4.2 include the total area of the change detection polygons, the approximate ODOT landslide area, and the absolute minimum and maximum movements among all change detection polygons. Change detections were typically indicated over a small area (usually <20%) of the approximate landslide area. Oddly, the seven sites with a maximum movement of over 6 ft do not report any crack or dip related movements. It is likely that these movements have not affected the road to any significant degree. There are no other

measurements available within the ODOT inventory to make a more direct comparison to the large rate of landslide movement indicated by lidar change detections.

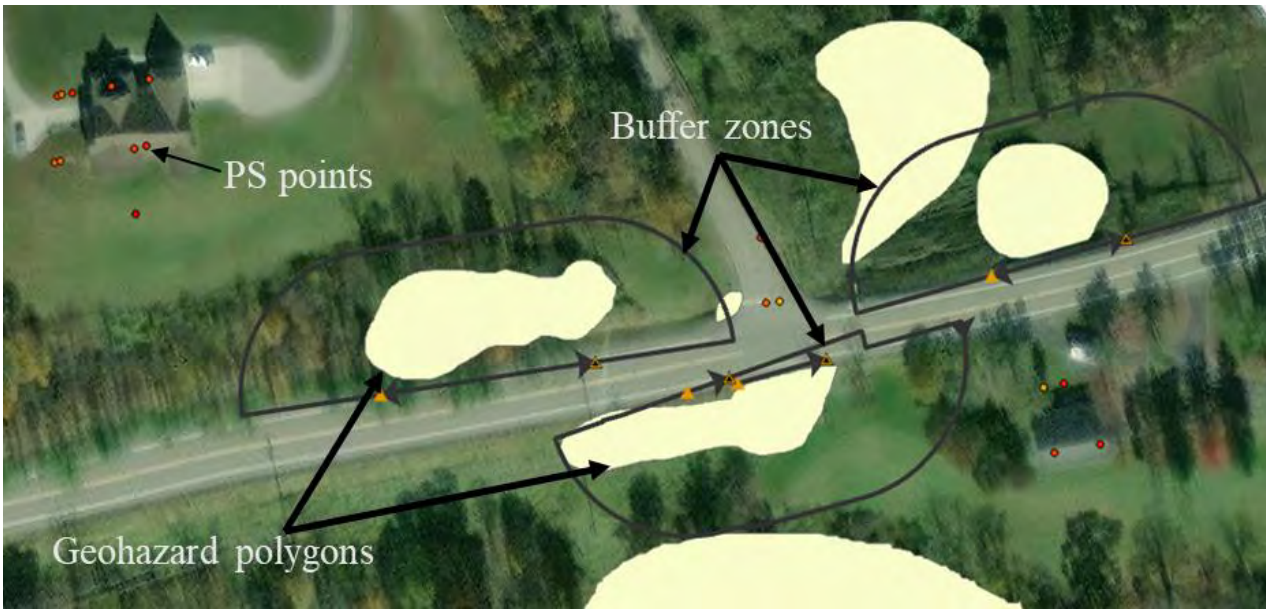
Table 4.1. Lidar-based change detection metrics and comparisons at 12 ODOT sites.

Landslide ID	Approx. area of ODOT LS (sqft)	Total area of change detection polygons (sqft)	Min. change movt. over LS (ft)	Max. change movt. over LS (ft)	ODOT Tier	Teren Ranking	ODOT crack hor. disp. (in)	ODOT dip vert. disp. (in)
LS00001485	4641	228	1	1.9	2	1	0	0.2
LS00002151	7938	488	1	6.4	1	3	0	0
LS00002354	18522	5697	1	6.8	1	5	0	0
LS00003377	14000	1665	1	8.5	4	5	0	0
LS00006384	8732	1060	1	7.0	1	1	0	0
LS00006795	4240	512	1	3.3	2	5	0.25	0
LS00006904	47672	17045	1	7.4	2	3	0	0
LS00007622	3612	968	1	5.4	2	8	0.5	1
LS00007816	66864	41	1	3.2	2	4	0	1
LS00007830	9150	1376	1.9	9.3	1	5	0	0
LS00008599	9282	458	1	2.2	2	4	0.75	0
LS00008816	11340	997	1	6.9	1	5	0	0

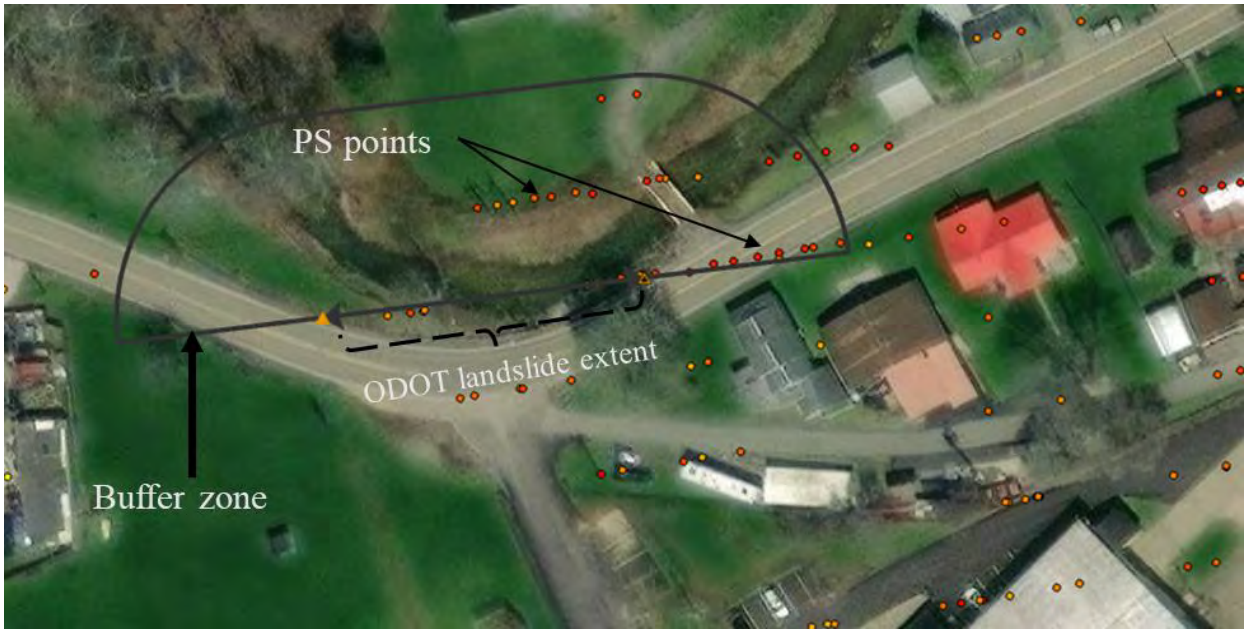
Note that the movement direction of the change detection polygons as uplifting or subsiding is not directly provided by Teren. It is possible to approximate the maximum subsidence and uplift based on the colored raster-format "continuous change layers," but this has proven to be crude at best. Our team suggests that Teren update this feature and provide the true maximum subsidence and maximum uplift values, rather than absolute values, for more meaningful evaluations.

4.1.3 InSAR Persistent Scatterers

A total of 15 of the selected ODOT landslide sites lie within the InSAR study regions selected by EO59. For each of these ODOT sites a buffer zone is considered around the extent of the landslide area. Figure 4.13 shows examples of the created buffer zones around ODOT sites. ODOT sites shown in Figure 4.13(a) don't have any PS points within the created buffer zone whereas Figure 4.13(b) shows PS points inside and around the ODOT site. The PS points inside the buffer zone, as well as those near and along the adjacent roadway, were considered relevant to the inventoried landslide extent. However, the PS points away from the landslide extents over nearby buildings were not considered relevant to potential landslide movement.



(a)



(b)

Figure 4.13. Examples of buffer zone created around landslide site: (a) example with no PS points within buffer zone; (b) example where important PS points lie outside of buffer zone (the points along the roadway opposite the stream were additionally considered).

Table 4.2 depicts PSI metrics for 12 ODOT sites, along with the ODOT Tier, Teren ranking (where available), and horizontal crack and vertical dip measurements of the road. The number of relevant PS points, and the absolute cumulative displacement (*abs. cum. disp.*) between Fall 2020 and Spring 2023 determined from those points is indicated for each site. Altogether, only eight sites were indicated to have relevant PS points, with a range of maximum displacement from ~2-36 mm. Horizontal crack and vertical dip displacements (*ODOT crack hor. disp.* and *ODOT dip vert. disp.*) were available at two of those eight sites and are included for comparison. Of the eight detected sites, two were ODOT Tier 2, and six were ODOT Tier 1 sites. The three sites with the largest movements detected by A-DInSAR (i.e., greater than 10 mm over the 2.5-year study period) were all risk Tier 1 sites. Furthermore, these sites were not captured by the lidar datasets. The ranging accuracy of lidar is typically around 50 mm, and it is unlikely that change detections of small movements at this scale could be detected. Within the entire database considered, only two sites (LS00002354 and LS00007772) were captured by both the lidar geohazards and the PS points. Of these, only LS0002354 was captured with lidar change detections.

Table 4.2 InSAR data comparisons for 15 ODOT sites.

Landslide ID	County/state route	No. of PS (within & near buffer)	Abs. cum. disp. (mm)	Teren Ranking (N/A – no geohazard polygon)	ODOT Tier	ODOT crack hor. disp. (in)	ODOT dip vert. disp. (in)
LS00004788	Jeff SR160	1	4.2	N/A	2	0	1.5
LS00005475	Jeff SR160	5	1.9	N/A	2	0.25	0
LS00005567	Jeff SR160	0	0	N/A	2	2	0
LS00008037	Jeff SR160	20	11.8	N/A	1	0	0
LS00002045	Mon E SR78	0	0	N/A	1	0	0
LS00002149	Mon E SR78	5	25.1	N/A	1	0	0
LS00002150	Mon E SR78	0	0	5	1	0	0
LS00002151	Mon E SR78	0	0	3	1	0	0
LS00002354	Mon E SR78	1	8.2	5	1	0	0
LS00005187	Mon E SR78	0	0	5	1	0	0
LS00011112	Mon E SR78	0	0	5	1	0	0
LS00007772	Mon SR7	2	2.6	5	1	0	0
LS00010377	Mon SR7	6	35.9	N/A	1	0	0
LS00010378	Mon SR7	1	3.2	N/A	1	0	0
LS00002018	Mon W SR78	0	0	1	1	0	0

4.2 Performance of Example Landslide Sites

Selected case studies are presented herein to showcase the favorable and contrasting performance of the lidar and/or InSAR datasets with the ODOT landslide inventory. Potential reasons for these discrepancies are also discussed herein.

4.2.1 Example Site 1: LS00002354

This Tier 1 site is located in Monroe County on State Route 78 East. For this site, all remote sensing datasets indicate movements: lidar geohazard polygons, lidar change detections, and PS points from InSAR.

Details from the ODOT inventory for this site are as follows: remediated with H-piles (remediation occurred at some point since the first inspection in 2011; however, this site was rated as Tier 1 during that 2011 inspection as well); soil origin is fill; soil type is A-3; it is reported that the slide affects the guardrail; no crack or dip movements were reported; and no cause of landslide is reported. The occurrence score is 2, and the impact score is 1. It is possible that the remediation measures influenced the remote sensing detections described herein, especially if the remediation was initiated during the Fall 2020 to Spring 2023 study period.

Lidar detects the geohazard polygon at the site with full coverage (FC). The Teren ranking of 5 is assigned to the geohazard polygon at this site. Figure 4.14 shows lidar detected geohazard and change detection polygons for the site. Maximum change movement detected by lidar is about 7 ft (subsidence). Lidar performed well in detecting the overall landslide extent, however the lidar-derived ranking and change detection do not seem to agree with the Tier 1 determination for this site. The change detection polygons were located near the toe of the slope. Because the slope has been remediated with H-piles, movement below the remediation is not of significant concern to ODOT and would result in the Tier 1 rating.

The A-DInSAR analysis detected one PS point near the site, as indicated in Figure 4.19, with a cumulative displacement of ~8 mm (0.3 in). The accuracy of detecting long term landslide movements with only one PS point is questionable and can in no way delineate the extent and orientation of a slide such as this without additional data. Figure 4.15 shows the full PSI displacement time series between Fall 2020 to Spring 2023 for this PS point. The time series depicts oscillating movements for this time interval, as typical for PSI results. However, a long-term trend can also be seen as depicted by the regression line, supporting the obtained displacement. It is likely that the inability to obtain additional PS points can be attributed to the high vegetation cover over the site as shown in the Google earth image in Figure 4.16.

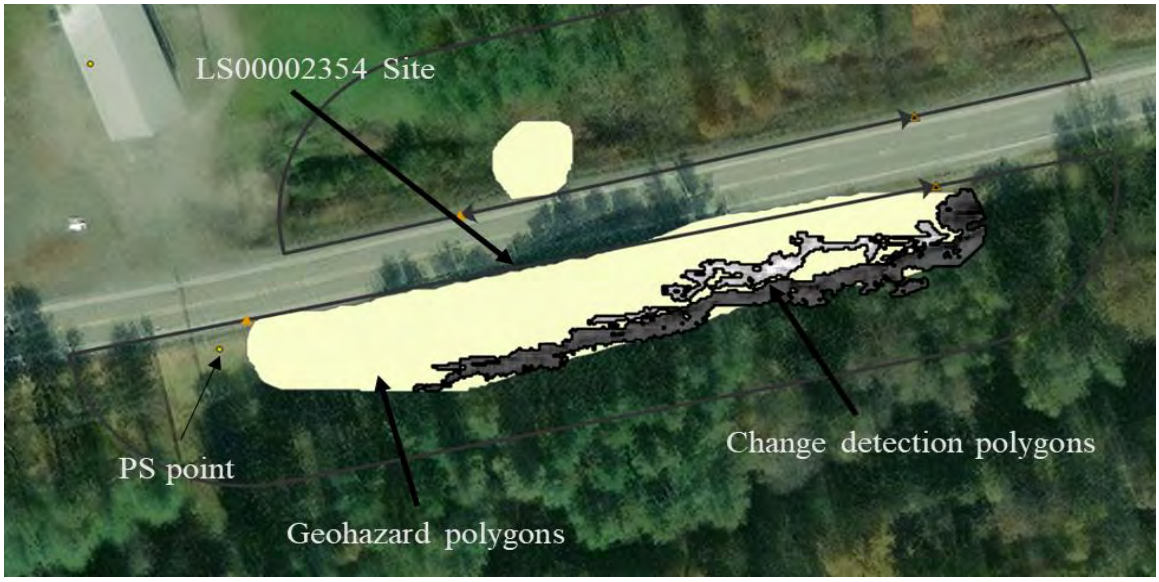


Figure 4.14. Lidar and InSAR detections of site LS00002354.

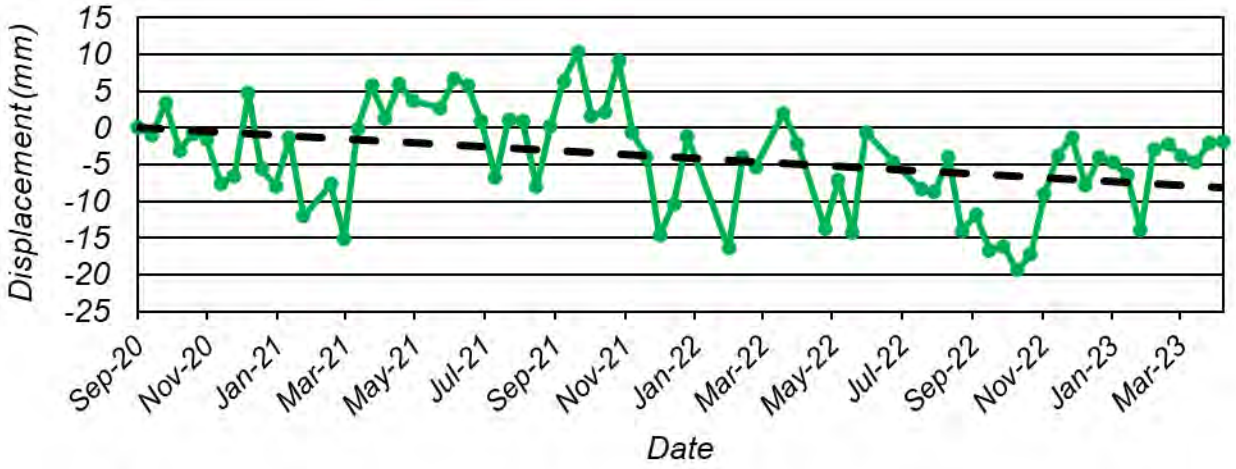


Figure 4.15. PS point displacement time series (solid green) and regression line (dashed black) near site LS00002354.

Figure 4.16. Google street view image of vegetation cover around site LS00002354 (Google 2023).

4.2.2 Example Site 2: LS00006904

This Tier 2 site is located in Guernsey County along the heavily trafficked Interstate Route 70 East. This site was visited by members of OSU, E.L. Robinson, Terracon, and ODOT on May 10, 2023. The site indicated soil displacements visible in Figure 4.17. The toe of the landslide is about 25 ft away from the nearest interstate lane boundary (i.e., solid white line in Fig 4.17b). This site was detected by both lidar-based geohazard and change detection polygons. The site is outside of the area covered by InSAR data.

Details from ODOT inventory for this site are as follows: non-remediated; soil origin is weathered claystone rock; soil type is A-7; landslide movement type is rotational; cause of landslide is attributed to presence of soft red clay which does not hold its form properly upon erosion and precipitation; the site is unlikely to affect the roadway but may clog the drain; no crack movements are reported. It is believed that slope instabilities at this site occurred within the red beds discussed in section 2.1.

Lidar detects a geohazard polygon at the site with full coverage (FC) and a Teren risk ranking of 3, as shown in Figure 4.18. Maximum movements detected by the lidar change detection is ~7.5 ft (subsidence). The lidar change detection extents appear to closely match the extents of the ground observations. Even with widespread landslide movement (occurrence score of 3), the site is Tier 2 due to its distance from the road (impact score of 1). Overall, lidar proved to be an effective method of remote sensing for this site. It is possible that the exposure of this landslide (without a thick tree canopy) helped to improve these results.

(a)

(b)

Figure 4.17. Photos from May 10, 2023 field visit of site LS00006904.

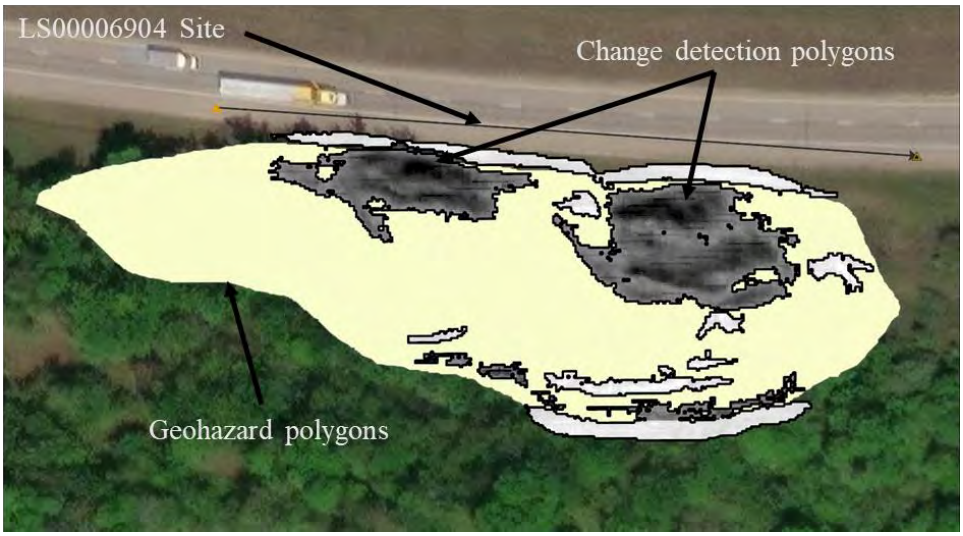


Figure 4.18. LiDAR detected geohazard polygon and change detection for site LS00006904.

4.2.3 Example Site 3: LS00008037

This Tier 1 site is located in Jefferson County along SR 150. This is a case where InSAR performed well relative to lidar.

Details from the ODOT inventory data for this site are as follows: non-remediated site with clayey silt soil type; some riprap is present at the site; type of landslide movement is not reported; no crack movements reported; and cause of landslide is not reported. The site is mapped in Figure 4.19 and is depicted in Figure 4.20.

Lidar could not detect any geohazard polygons for this site as shown in Figure 4.19. This is likely due to the coarser precision of the lidar geohazard polygon and change detections (i.e., typically ~14 cm) relative to the slow movements at this site picked up by InSAR.

InSAR detected many PS points within and around the buffer zone shown in Figure 4.19. The PS points around the site indicate cumulative displacement of ~12 mm (0.5 in). The displacement time series plot for 5 PS points near the site is shown in Figure 4.21a. These points are mapped in Fig 4.21b. The displacement time series plot shows recent significant movements between January and March 2023. ODOT's latest inspection was completed in January 2023, but there were no reported movements at the time. This is expected because the movements started to occur following the inspection. Regardless, it is possible for a field inspector to miss movements of less than 2 cm if cracks or other observable features are not visible. InSAR may be invaluable for assisting with long-term monitoring at a site like this.

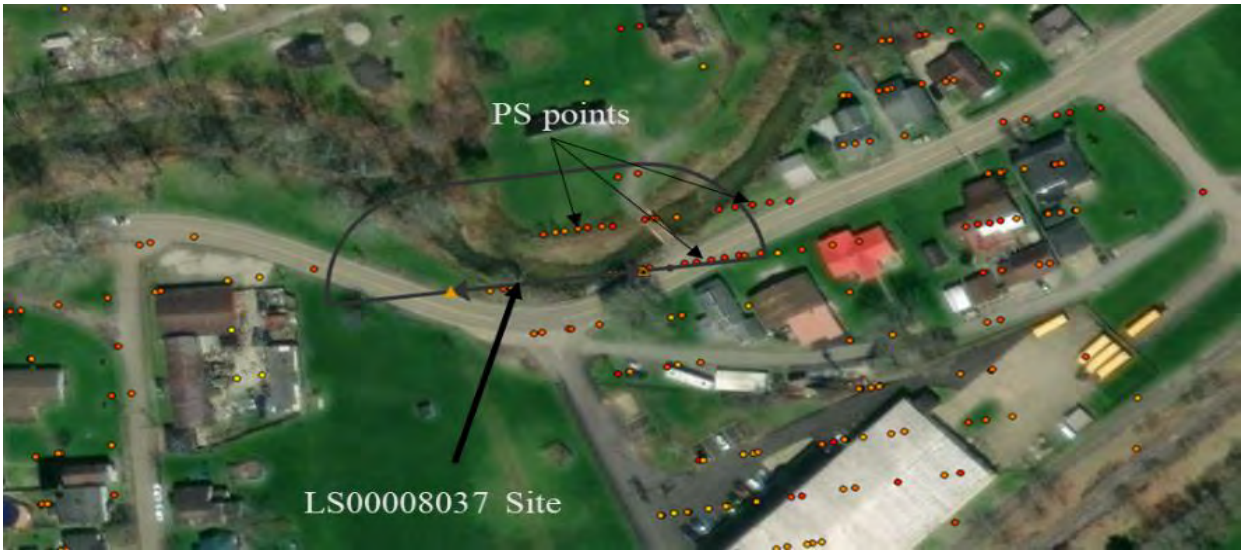


Figure 4.19 Site map for LS00008037 showing nearby PS points.

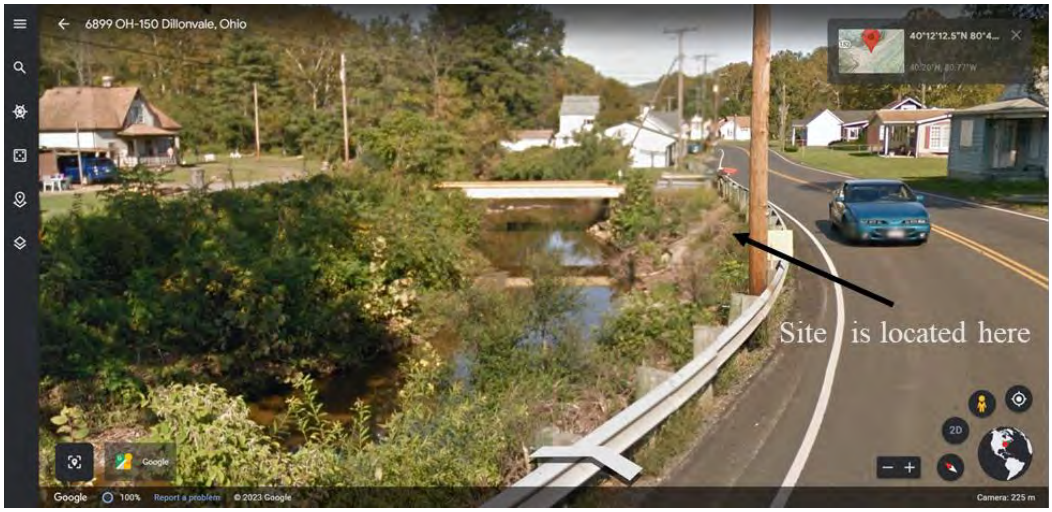


Figure 4.20. Google street view image for site LS00008037 (Google 2013).

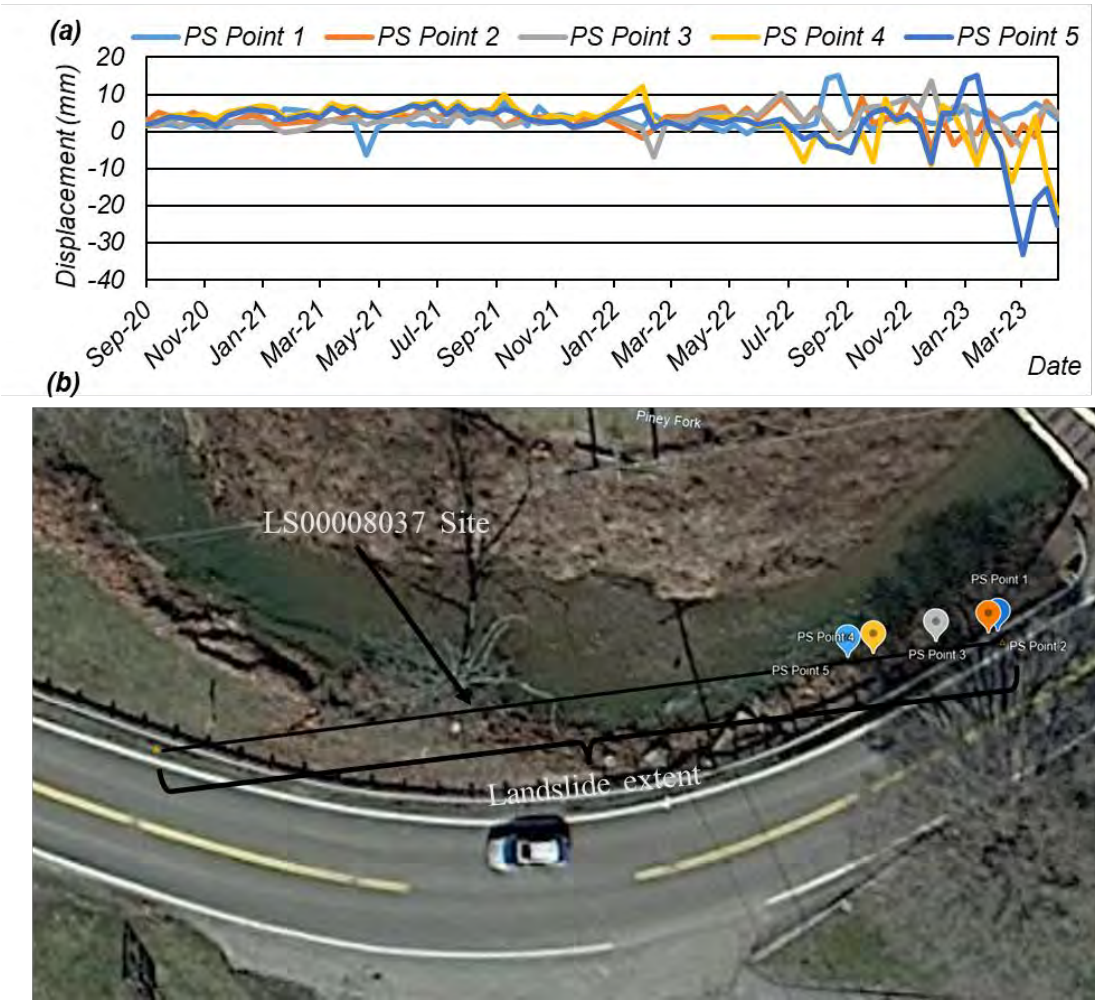


Figure 4.21. (a) Displacement time series near site LS00008037 for different PS points (b) location of PS points around the site LS00008037 (Google 2021a).

4.3.3 Example Site 4: LS00008440

This is a Tier 3 site located in Guernsey County along State Route 513. This site was visited by members of OSU, E.L. Robinson, Terracon and ODOT on May 10, 2023. The site was recently remediated after developing large cracks in the pavement. The site is located at the corner of a high slope, making it more vulnerable. Drilled shafts of 2 ft diameter have been placed for remediation by ODOT as seen in Figure 4.23a. During the site visit, an obvious bend was observed along the roadside guard rail due to past landslide movements as shown in Figure 4.23b. The site lies outside the InSAR coverage area.

Lidar was not able to detect any geohazard polygons around this site as shown in Figure 4.24. This may have been due to several factors, including the high density of vegetation around this site (Figure 4.25), the small scale of the landslide, and an influence from the recent remediation.

(a) Recent remediation

(b) Bending in guardrail.

Figure 4.23 Photos from May 10, 2023 field visit showing remediation and bending in guardrail of site LS00008440.

Figure 4.24 No detection of geohazard polygon for site LS00008440.

Figure 4.25 High vegetation cover over site LS00008440 (Google 2021b).

4.3 General Observations

Some of the most salient observations from these comparisons are:

- 61% of the inventoried landslides with an occurrence score 1 (11 of 18), and 32% of the inventoried landslides with an occurrence score 2-4 (26 of 81) were not indicated by the geohazard polygons (i.e., NE or ND). This difference in percentages suggests that lidar is more likely to detect sites that show greater evidence of occurrence in the field surveys.
- 95 lidar-detected landslides (from the geohazard polygons) were not associated with the 99 ODOT landslides, which would suggest they are either (1) false positives by the lidar approach, (2) they were missed by the field surveys, or (3) they were part of the greater ODOT database not assessed in this study. The third situation has not been spot checked for every case by our research team. For example, LS00004980 and LS00009560 are Tier 1 sites picked up by lidar (slip IDs #1843 and #7064), but they are not part of the 99 selected sites. It is likely there are several similar cases, especially as the landslide dashboard (ODOT 2023b) currently indicates 2585 active landslides within the six counties considered in this study.
- The Teren geohazard assessment ranking system is currently incompatible with the ODOT risk Tier. However, such a ranking system can be re-configured as needed.
- As expected, the lidar change detection polygons were more likely to capture sites with a higher risk Tier. A lowering of the 1 ft threshold value is anticipated to detect more sites, however, this may come at the expense of greater noise and uncertainty. Lidar technology is improving, so this accuracy will become better over time.
- The 3 landslides with the largest movements detected by A-DInSAR (i.e., greater than 10 mm over the 2.5-year study period) were all risk Tier 1 sites. Furthermore, these sites were not captured by the lidar datasets. This suggests a unique ability of InSAR methods to detect and monitor subtle movements that may not be readily apparent from field surveys and lidar data, under optimal conditions.
- The inability of A-DInSAR to capture at least 10 mm of movement at 12 of the 15 considered sites is primarily due to the heavy vegetation and associated lack of coherency for obtaining relevant PS points. This suggests a need for higher resolution data to produce more meaningful results.

CHAPTER 5: ADVANTAGES AND LIMITATIONS OF ALTERNATIVE METHODOLOGIES FOR LANDSLIDE INVENTORY UPDATING

This section highlights some of the relative advantages and limitations of the specific lidar and InSAR methodologies used in this study for their specific potential use in updating the ODOT landslide inventory. These advantages and limitations are based on (1) insights from the resulting comparisons to the 99 ODOT inventoried landslides, (2) the research team's discussions with the data providers (Teren and EO59), and (3) available relevant research concerning these technologies.

5.1 Lidar Change Detections

Two lidar-based approaches developed by Teren are used in this study for landslide inventory updating: (1) the geohazard detection and ranking system as obtained from a single lidar-derived DEM, and (2) the change detections obtained as the difference of two DEMs. The advantages and limitations of both approaches are considered together herein.

5.1.1 Advantages

- **Ease of integration** – The lidar data is closely compatible for near-future integration with the current ODOT landslide inventory. The geohazard detection allows for a clear delineation of landslide boundaries. The ranking system developed by Teren can be modified for greater compatibility with the ODOT Tier rating system. The change detection approach can provide additional details regarding the activity of inventoried landslides, for inclusion with a lidar-based ranking system.
- **Landslide occurrence detection –** As observed from the results of this study, 62 of the 99 ODOT landslides were at least partially captured by the lidar-based geohazard delineations (~63% success rate). Also, 55 out of the 81 ODOT landslides with an occurrence probability score of 2 or higher were captured (~68% success rate). The slightly higher capture rate for sites with higher occurrence is as expected. Slides that are more visible from field surveys will likely be more visible from lidar. The sites not captured may be due to inaccuracies and other uncertainties (see limitations).
- **Impact to assets detection** – The digital elevation and terrain models (DEMs and DTMs) produced by lidar data, and the ability to use this data to delineate landslide boundaries, can allow for simple, automated tools for defining impacts to ODOT assets (e.g., distance to roadway relative to scale and orientation of landslide). While the Teren ranking system currently considers impacts to pipelines, it can be adjusted to consider features relevant to roads and other ODOT assets.
- **Geologic considerations** – Lidar assessments associated with DEMs can be configured to detect such items as topographic textures along slope surfaces, erosional features near rivers, and hydraulic influences (e.g., water collection within gullies or other topographic reliefs), among other features.
- **Becoming state-of-practice** – As discussed in Chapter 2, lidar DEMs have been applied for landslide inventories by US state agencies for over a decade. Change detections from multi-temporal lidar DEMs appear to be gaining more attention as well.

5.1.2 Limitations

- **Data collection frequency** – The frequency of lidar data depends on the availability of airborne data collection. Data collection can be costly, especially if the data and thus cost are not shared with other regional projects.
- **Accuracy** – The vertical and horizontal accuracy for the datasets provided by Teren were stated as within 14 cm and 40 cm, respectively. This is much greater than the relative millimeter scale accuracy from InSAR time series analyses. However, future developments are expected to continually improve the accuracy of lidar.
- **Uncertainties** – Past studies of change detection methods (e.g., Mora et al. 2018, Burns et al. 2010) suggest that uncertainties in lidar data acquisition and data processing can be significant. Heavy vegetation during the spring season in Ohio can also reduce the data resolution.

5.2 InSAR Change Detections

The advantages and limitations of the A-DInSAR methodology developed by EO59 is considered herein.

5.2.1 Advantages

- **Data collection frequency** – The high frequency of InSAR data collection (e.g., every 12 days with Sentinel-1 for a single orbit direction) provides the unique ability of closely monitoring movements. The case history at ODOT landslide LS00008037 showcases the ability of InSAR to detect recent movements (over the last one year) of a roadside riverbank, that was not detected by lidar (see details in section 4.2.3).
- **High reliability** – The high frequency of data collection improves the temporal reliability of slow movements over a long time period. This can potentially be more reliable than change detections from lidar that are typically based on two (or a small handful of) scans spaced over months or years.
- **Compatibility with other approaches** – The InSAR approach considered herein can be combined with other datasets (e.g., DEMs from lidar, lidar derivative attributes, aerial images) to better delineate and evaluate the activity of potential landslides.
- **Future potential** – As discussed in Chapter 2, satellite coverage is continuing to improve and become more accessible, as well as cost effective. InSAR methodologies relevant to landslide inventory updating are also continuing to improve through additional research.

5.2.2 Limitations

- **Data sparsity** – The ability to collect a significant number of meaningful persistent scatterer (PS) points significantly depends on the actual object space conditions. Areas that are heavily vegetated will provide fewer points for analysis relative to surfaces with higher reflectivity (e.g., buildings, infrastructure, or surface features that remain stable over time). In some cases, no relevant PS data will be obtained, as observed for 7 out of the 15 evaluated ODOT landslide sites. This can be improved with higher resolution (e.g., X-band) satellite data (e.g., Antonielli et al. 2019). Furthermore, despite a high temporal resolution, the spatial resolution of lidar is typically much greater than InSAR (especially when considering processing costs).
- **Landslide delineation –** The spatial extents of a landslide cannot be delineated from PS points without additional data. This information is crucial for evaluating the impact of a landslide to nearby assets.
- **Landslide orientation bias** – The orientation of the satellite line of sight (LOS) relative to the landslide slope aspect can influence the results. Currently, only the ascending orbit direction of Sentinel-1 is available in Ohio. This LOS provided by this ascending orbit is more likely to provide more PS points for east-oriented landslides (i.e., because the slope is roughly parallel to the satellite LOS), rather than west-oriented landslides. Geometric distortions such as foreshortening, layover, and shadow effects can also adversely affect the results as dependent on the slope aspect and topographic details (e.g., Antonielli et al. 2019).
- **Event bias** – The A-DInSAR methodology used herein is best-suited for slow moving landslides. Landslides that may occur immediately (e.g., during or following a major storm or other extreme event), may greatly reduce the coherency of the SAR data.

CHAPTER 6: FINDINGS AND RECOMMENDATIONS

The study herein focused on the evaluation of remotely sensed lidar and InSAR datasets for interpreting change detections of inventoried eastern Ohio landslides. Lidar-derived landslide delineations and change detections were provided by specialty firm Teren near a subset of 99 ODOT inventoried landslides. The A-DInSAR methodology was used by specialty firm EO59 near a subset of 15 ODOT inventoried landslides. The results showed that 62 of the 99 ODOT landslides were at least partially captured by the lidar-based geohazard polygons, 12 of the 99 ODOT landslides were detected by lidar-based change detections for over 1 m of movement, and 3 of 15 ODOT landslides considered with A-DInSAR detected at least 10 mm of filtered movement.

Following are the overarching findings of this study:

- The lidar and InSAR methods used herein each possess their own advantages and limitations.
- The lidar methods used herein can be most readily incorporated within the ODOT landslide inventory because they can delineate landslide extents, provide a ranking system, and have shown reasonable success for detecting landslides for this and similar studies.
- The lidar methods used herein tended to better capture sites with ODOT risk Tiers greater than 1 (particularly those with occurrence scores greater than 1).
- The InSAR methods used herein can be advantageous when applied in combination with other datasets (e.g., DEMs from lidar, lidar derivative attributes, aerial images), especially for their ability to monitor slow-moving landslides. The utility of InSAR for such work is expected to improve over time.
- Both technologies are rapidly continuing to develop and find greater practical use for landslide detections and inventory updates. In particular, the use of InSAR is increasing at a fast pace.
- Ultimately this work is anticipated to support the potential adoption of remote sensing technologies to supplement or substitute current ODOT landslide inventory field surveys. Our research team believes that in the near-term, the integration of lidar-based approaches with the landslide inventory can potentially increase landslide detection reliability and reduce overall costs. InSAR may additionally be considered for either indicating subtle movements for lower risk Tier landslides, or frequently monitoring movements of higher risk Tier landslides.

Some limitations and recommendations for future studies include:

- This study was limited to a subset of 99 inventoried ODOT landslides. Only 15 of these sites were considered with the InSAR methodology. This sample size may not completely represent the entire ODOT landslide inventory, especially considering the various factors that could affect remote sensing interpretations.
- Future work should consider adjusting the lidar-derived change detection threshold which was set at 1 foot for the study herein to obtain a more optimal balance of detected landslides and minimized uncertainties.
- Future work should also consider adjusting the geohazard ranking system provided by Teren to better match the considerations used to determine the ODOT risk Tiers.

- Future work could consider the benefits of higher resolution (e.g., X-band) InSAR data for better capturing heavily vegetated sites.
- Future effort will be needed to integrate the remote sensing approaches evaluated herein for compatibility with the current ODOT inventory.

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APPENDIX A: SELECTED SITES FROM ODOT INVENTORY

APPENDIX B: FIELD REPORT FOR VISITED LANDSLIDE SITES

APPENDIX C: RESOURCES FROM TEREN (LIDAR)

APPENDIX D: RESOURCES FROM EO59 (INSAR)

APPENDIX A:

SELECTED SITES FROM ODOT INVENTORY

- ODOT inventory data table for selected 99 sites with selected parameters used in analysis.

(Note: Last 2 columns are Slip ID and Coverage category for Teren geohazard polygons)

APPENDIX A

Selected Landsldie sites from ODOT inventory

LANDSLIDE_SITE_ID	CRS	LS_OCCURRENCE_PROB	LS_IMPACT_PROB	TIER	REMEDIATION	APPROX. LANDSLIDE AREA (sqft)	ESTIMATED_SLOPE_HEIGHT (ft)	SLIDING_SURFACE_DEPTH (ft)	AVERAGE_SLOPE_ANGLE (degrees)	TYPE_OF_MOVEMENT	LANDSLIDE COVERAGE	SLIP_ID
LS00001485	NOB-147-18.819	2	2	2	Non-remediated	47672	11	6	34	Slide,Rotational	FC	524
LS00001907	MOE-78-0.411	2	1	1	Non-remediated	64780	22	9	39		LH	629
LS00001911	MOE-78-12.608	2	1	1	Non-remediated	64780	63	8	30		LH	563
LS00001945	MOE-78-3.863	2	1	1	Remediated	8050	27	5		Slide - Rotational	LH	27
LS00002014	MOE-78-4.950	2	1	1	Non-remediated	1008	14	5	40		MH	40
LS00002018	MOE-78-13.302	1	1	1	Non-remediated	1008	12	5	31		NE	13
LS00002045	MOE-78-20.113	2	1	1	Remediated	65625	21	5			FC	14
LS00002149	MOE-78-19.198	2	1	1	Non-remediated	70740	15	4	31		ND	#N/A
LS00002150	MOE-78-19.433	2	1	1	Non-remediated	70740	10	3	28		LH	615
LS00002151	MOE-78-20.149	2	1	1	Remediated	73920	32	4	90		FC	15
LS00002212	MOE-78-23.427	2	1	1	Non-remediated	90552	33	3	40		NE	#N/A
LS00002214	MOE-78-25.016	2	1	1	Non-remediated	90552	18	5	20		FC	617
LS00002254	MOE-78-2.244	2	1	1	Non-remediated	23661	27	9	32		FC	41
LS00002339	NOB-147-18.426	1	2	1	Non-remediated	8640	12	4	30		NE	#N/A
LS00002354	MOE-78-19.408	2	1	1	Remediated	2928	20	4			FC	16
LS00002363	MOE-78-23.810	2	1	1	Non-remediated	1722	29	4	29		NE	#N/A
LS00002364	MOE-78-24.148	2	1	1	Non-remediated	3472	13	3	35		ND	#N/A
LS00002388	MOE-78-24.872	2	1	1	Non-remediated	3472	19	3	29		FC	618
LS00002956	MOE-255-17.866	2	1	1	Remediated	8712	16	4	25		NE	#N/A
LS00002957	MOE-255-17.877	2	1	1	Non-remediated	5376	13	3	35		FC	631
LS00003190	MOE-255-17.323	2	1	1	Non-remediated	5376	15	4	45		FC	19
LS00003376	MOE-255-17.382	2	1	1	Non-remediated	3780	20	3	40		MH	550
LS00003377	MOE-255-17.774	4	4	4	Remediated	1666	100	15	20	Slide - Rotational	MH	630
LS00003431	MOE-255-17.270	3	4	4	Remediated	1666	34	8	35	Slide - Rotational	FC	551
LS00003493	MOE-255-17.497	2	1	1	Non-remediated	5952	17	3	35		FC	546
LS00003504	MOE-255-17.586	2	1	1	Non-remediated	5360	82	12	15	Slide - Rotational	FC	30
LS00004501	BEL-250-4.321	2	2	2	Remediated	3393	40	2	20	Slide,Complex	FC	37
LS00004719	BEL-9-0.632	1	2	1	Remediated	33350	17	3	35		FC	542
LS00004788	JEF-150-4.670	2	2	2	Non-remediated	3528	61	4	27	Slide - Rotational	NE	#N/A
LS00004900	HAS-9-14.035	1	1	1	Non-Remediated	7519	58	3	27		NE	#N/A
LS00004926	GUE-70-19.387	1	1	1	Remediated	0	19	4	30		ND	#N/A
LS00005045	BEL-147-2.845	1	1	1	Remediated	6570	13	4	20		FC	567
LS00005085	HAS-9-14.058	2	2	2	Non-remediated	14100	15	4	33	Slide,Rotational	FC	535
LS00005187	MOE-78-20.106	2	1	1	Non-remediated	15680	26	4	34		FC	14
LS00005190	NOB-147-16.348	1	1	1	Remediated	12600	8	8	90		LH	20
LS00005227	HAS-9-14.115	2	1	1	Non-Remediated	40896	23	3	28		FC	536
LS00005228	HAS-9-14.554	2	1	1	Non-remediated	55500	13	3			MH	570
LS00005229	HAS-178-0.094	2	1	1	Non-Remediated	27500	40	4	36		NE	#N/A
LS00005239	HAS-151-19.669	2	1	1	Non-Remediated	27500	13	3	47		ND	#N/A
LS00005295	HAS-9-13.841	2	1	1	Non-remediated	27500	15	6	45		NE	#N/A
LS00005297	HAS-151-19.880	2	1	1	Non-Remediated	1518	9	4	31		ND	#N/A
LS00005455	HAS-151-19.564	1	1	1	Non-remediated	2002	6	2	22		FC	624
LS00005475	JEF-150-5.253	2	2	2	Remediated	2002	8	2	38	Slide,Translational	ND	#N/A
LS00005567	JEF-150-4.727	2	2	2	Non-remediated	3612	54	6	32	Slide - Rotational	NE	#N/A
LS00006360	BEL-147-2.770	2	2	2	Non-remediated	4500	10	5	16	Slide,Rotational	MH	528
LS00006361	BEL-147-3.434	2	1	1	Non-remediated	4500	22	3	27		NE	#N/A
LS00006384	GUE-513-4.311	1	2	1	Non-remediated	16646	11	3	24		FC	578
LS00006794	GUE-265-12.788	1	1	1	Non-remediated	8930	13	1	35		NE	#N/A
LS00006795	GUE-265-9.123	2	2	2	Non-Remediated	7755	20	3	27	Flow - Slow Earth	FC	619
LS00006893	HAS-151-21.078	1	1	1	Non-remediated	42750	5	1	21		ND	#N/A
LS00006894	GUE-513-9.847	2	2	2	Non-Remediated	47250	16	5	29	Slide - Rotational	LH	607
LS00006903	GUE-70-26.215	2	1	1	Non-remediated	47250	24	3	32		FC	21
LS00006904	GUE-70-18.747	3	1	2	Non-remediated	66864	34	13	30	Slide - Rotational	FC	43
LS00007054	GUE-265-14.686	2	1	1	Non-remediated	33810	13	4	40		MH	584
LS00007062	GUE-70-26.503	2	1	1	Non-remediated	9150	36	4	35		MH	108
LS00007064	GUE-70-18.660	2	1	1	Non-remediated	11394	22	6	39		FC	42
LS00007187	NOB-513-6.611	2	2	2	Non-remediated	1620	25	1	24	Slide - Rotational	FC	589
LS00007357	BEL-9-12.395	2	2	2	Non-remediated	2520	9	2	31	Slide,Rotational	ND	#N/A
LS00007381	NOB-513-3.648	1	2	1	Non-remediated	2520	32	8	31		NE	#N/A
LS00007383	NOB-513-3.490	2	1	1	Remediated	8140	14	8	35		NE	#N/A
LS00007388	NOB-513-3.553	2	2	2	Non-remediated	8140	38	1	33	Slide,Rotational	MH	590
LS00007389	NOB-513-0.653	3	3	3	Non-remediated	8140	7	3	27	Slide,Rotational	NE	#N/A
LS00007474	NOB-513-6.695	2	1	1	Remediated	11220	27	2	90		FC	589
LS00007481	NOB-513-3.388	2	2	2	Non-remediated	20111	25	8	26	Slide,Rotational	LH	608
LS00007541	BEL-70-6.277	2	1	1	Non-remediated	20111	42		42		FC	605
LS00007558	BEL-9-9.412	2	1	1	Remediated	18900	43	10	20		LH	612
LS00007559	BEL-9-9.994	2	2	2	Remediated	1848	6	5	38	Slide - Rotational	NE	#N/A
LS00007622	NOB-513-6.561	2	2	2	Remediated	1848	6	2	34	Slide - Translational	FC	589
LS00007677	NOB-147-17.982	2	1	1	Non-remediated	3025	22	4	33		FC	627
LS00007772	MOE-7-15.932	2	1	1	Non-remediated	2592	12	3	29		LH	594
LS00007816	NOB-513-0.790	2	2	2	Remediated	2592	54	8	90	Slide,Rotational	FC	34

APPENDIX A Selected Landsldie sites from ODOT inventory

LS00007830	BEL-9-11.707	1	2	1	Remediated	2592	14	2	22		LH	597
LS00008037	JEF-150-6.954	2	1	1	Non-remediated	16380	4	3	37		ND	#N/A
LS00008041	GUE-513-5.071	2	2	2	Non-Remediated	11550	30	4	32	Slide - Rotational	FC	517
LS00008275	HAS-9-14.149	3	3	3	Non-remediated	11550	16	5	34	Slide,Rotational	FC	537
LS00008277	HAS-151-19.792	2	2	2	Remediated	11550	51	1	38	Slide,Rotational	LH	511
LS00008439	GUE-265-12.935	2	2	2	Non-Remediated	11550	13	5	34	Slide - Rotational	NE	#N/A
LS00008440	GUE-513-4.791	3	2	3	Non-Remediated	9282	36	5	26	Slide,Rotational	ND	#N/A
LS00008599	GUE-513-9.796	2	2	2	Non-Remediated	20500	17	6	33	Slide - Complex	FC	581
LS00008754	GUE-513-5.000	2	2	2	Non-Remediated	20500	29	8	31	Flow - Slow Earth	NE	#N/A
LS00008816	BEL-9-9.168	1	1	1	Remediated	3520	21	8	90		FC	24
LS00008912	BEL-9-1.016	2	2	2	Non-remediated	20500	12	5	33	Slide,Translational	NE	#N/A
LS00008935	BEL-147-1.994	2	2	2	Non-remediated	3520	9	5	33	Slide,Rotational	NE	#N/A
LS00009009	BEL-7-1.390	2	2	2	Non-remediated	27135	20	7	27	Slide,Rotational	NE	#N/A
LS00009162	BEL-147-3.209	2	2	2	Non-remediated	28135	12	4	30	Slide,Rotational	NE	#N/A
LS00009227	BEL-147-1.201	2	2	2	Non-remediated	34424	36	4	19	Slide,Rotational	ND	#N/A
LS00009403	MOE-78-3.930	2	2	2	Non-remediated	34424	21	6	20	Slide,Rotational	FC	613
LS00009556	BEL-147-2.957	2	2	2	Non-remediated	34424	21	5	23	Slide,Rotational	FC	530
LS00009742	MOE-255-17.452	2	1	1	Non-remediated	11340	20	2	25		NE	#N/A
LS00009744	MOE-255-17.716	2	1	1	Non-remediated	6160	23	4	40		ND	#N/A
LS00009951	GUE-22-26.044	2	1	1	Remediated	6160	17	4	24		ND	#N/A
LS00009973	BEL-7-5.654	2	1	1	Non-remediated	6160	30	5			ND	#N/A
LS00010377	MOE-7-15.882	1	1	1	Remediated	2461	10	4	30		NE	#N/A
LS00010378	MOE-7-16.135	1	1	1	Non-remediated	1330	7	3	29		ND	#N/A
LS00010383	BEL-9-12.218	2	2	2	Non-remediated	5184	13	3	32	Slide - Translational	ND	#N/A
LS00010388	BEL-70-8.038	1	1	1	Non-remediated	3770	48	3	28		ND	#N/A
LS00010617	BEL-147-2.903	2	2	2	Non-remediated	3770	11	4	31	Slide,Rotational	FC	623
LS00011034	MOE-255-17.545	1	1	1	Non-Remediated	3770	20	2	30		LH	545
LS00011112	MOE-78-20.065	2	1	1	Non-Remediated	1550	20	8	29		FC	506

APPENDIX B:

FIELD REPORT FOR VISITED LANDSLIDE SITES

- Field report for site visit on 10th of May 2023.
- Observations and importance information's from each 13 visited site is briefly described.

FIELD REPORT FOR VISITED LANDSLIDE SITES

Date: May 10, 2023

Introduction:

On Wednesday May 10, 2023, the members from OSU, Terracon, ELR, and ODOT visited 13 landslide sites (12 out of 17 originally planned sites; and 1 unplanned site). The goal of this site visit was to better understand ODOT's landslide inventory tier classification and note general observations that may influence aerial measurements. The sites we visited were in three different counties: Guernsey, Belmont, and Noble. This report has been drafted to summarize the observations for each visited site to better understand them. Sites visited were primarily Tier 1 or 2. There were only 2 sites with Tier 3 designation. The subsequent sections will discuss the preliminary observations at each site and the reasoning for their tier classification.

Site abbreviations represent county names: GUE represents Guernsey, BEL represents Belmont, and NOB represents Noble.

Sites Visited

1. **LS00006904 (GUE-70-18.747)**

Present Tier Classification: 2

Comments: It was T1 in 2017 and changed to T2 in 2023

The site is situated on Interstate 70, which has a heavy traffic load. The site shows large landslide movements and displacement of soil mass which can be seen in Figure 1. The toe of the landslide is about 25 ft away from the nearest interstate lane boundary (i.e., solid white line). This landslide appears active and would likely have a higher Tier than 2 if it was closer to the roadway. ODOT members told us that if this site were 30 ft further from road, it would be even less of a concern. Proximity to the major road and its effect on moving traffic greatly affects the ODOT landslide tier classification.

A wet decomposed claystone was visible along the base of the slide. Water appeared to be seeping from about four feet above the base, and ponded water was visible along the slope base. Overturned trees were abundant along the head scarp.

Figure 1 Photos from site visit for site LS00006904 (GUE-70-18.747).

2. **LS00006384 (GUE-513-4.311)**

Present Tier Classification: 1

Comments: Tier 1 since 2008

The site is situated along the state route 513. The site is heavily vegetated and located downslope of a rural road. There is no apparent sign of a landslide. For the last 15 years, the site has consistently been Tier 1. It's possible that one reason ODOT still has this site in its inventory is its proximity to the road and the possible threat it might develop if any movements occur.

Figure 2 Photos of site visit for site LS00006384 GUE-513-4.311

3. LS00008440 (GUE-513-4.791)

Present Tier Classification: 3

Comments: Since 2009 site was T2 and in 2019 it moved to T3.

The site is situated very close to the previous site (LS00006384) along the same state route 513. The site was recently remediated after developing large cracks in the pavement. The site is located at the corner of a high slope which makes it more vulnerable. The decision to move it to T3 was made based on developing cracks and the threat it poses to vehicular traffic. Drilled shafts (2 ft diameter and assumed max depth of 20-25 ft) have been placed for remediation by ODOT as seen in Figure 3. The roadside guard rail shows clear bending due to landslide movements. Figure 4 shows guard rails and cracks in the pavements.

The location of the site, i.e., at the corner of the high slope is a major reason for its T3 classification as even a small landslide movement will pose a greater risk to the traffic. If we compare this site with the first one (GUE-70-18.747) the landslide movement is not that large but due to its proximity to the road it has a higher tier classification.

ODOT suggested that bedrock was likely within 15 ft below the head scarp. Borings are available on the TIMS website. It is possible there was a water stream present near the base of the slope (difficult to see due to dense vegetation, but Google Earth confirms that a stream is typically there).

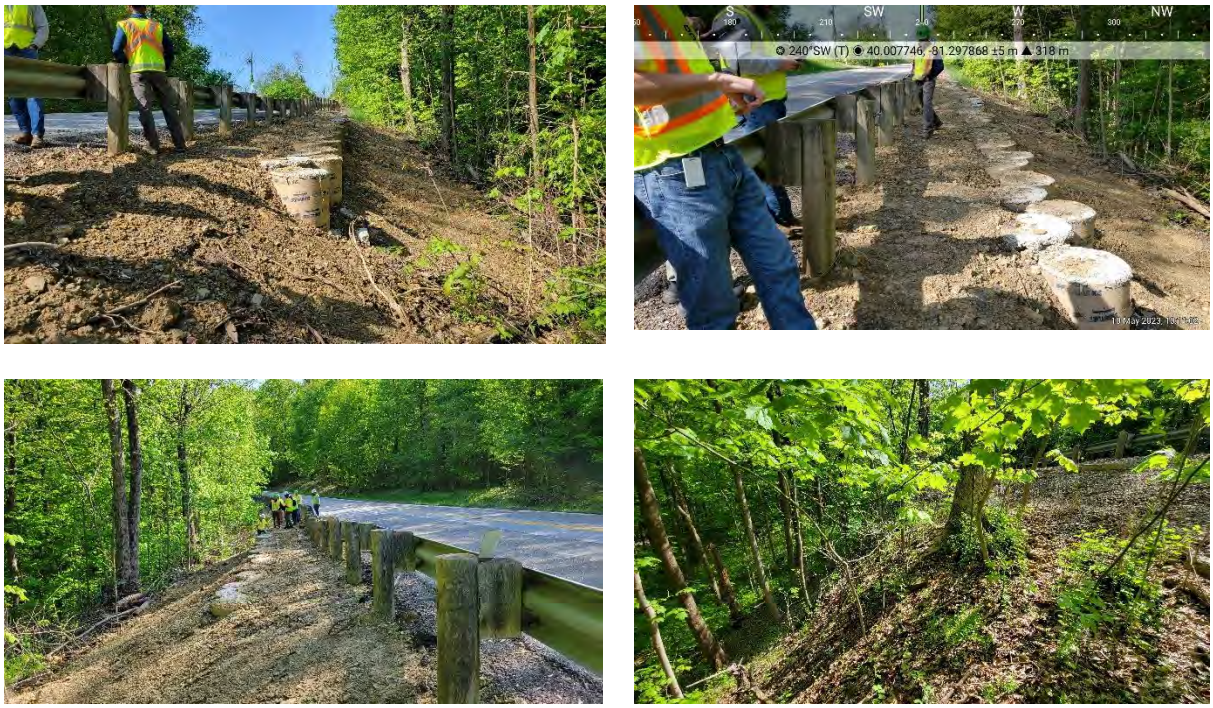


Figure 3 Photos of site visit for site LS00008440 (GUE-513-4.791) showing recent Remediation

Figure 4 Photos of site visit for site LS00008440 showing bending in guard rails and crack in the pavement.

4. LS00006794 (GUE-265-12.788)

Present Tier Classification: 1

Comments: Tier 1 since 2008

The site is situated adjacent to rural arterial route 265 as shown in Figure 5. There was no sign of active movements at the site. However, there is a 1-in thick crack present near the crest of the slope which suggests possible landslide movement. It is possible that the site is in the inventory because of this crack, however, no further movement was reported in the last 15 years.

The east side of the slope showed evidence of a vehicle impact (e.g., scoured base slope material) from a recent accident that appears to have damaged the guardrail at south of road. The south of road had also been remediated with 30 in diameter shafts (likely within 15 years old; remediation was not performed by ODOT).

UPDATES: Lidar – Not in extent (Landslide detected aligned perpendicular to ODOT's)

Figure 5 Photos of site visit for site LS00006794 (GUE-265-12.788).

5. **LS00008439 (GUE-265-12.935)**

Present Tier Classification: 2

Comments: Classified as T2 since 2013.

The site is situated close to GUE-265-12.788 along route 265, the guard rail shows clear bending. Also, there is some slight transverse cracking across the road pavement. Figure 6 shows the site location and bent guard rail. There was a small valley in the hill formation at the other side of the road. It is likely that this section of the roadway embankment is founded atop a greater thickness of fill which may have settled. Another possible cause of movement may be freeze-thaw action. The OSU team does not believe this was caused by a natural landslide.

Figure 6 Photos of site visit for site LS00008439 (GUE-265-14.935)

6. LS00007054 (GUE-265-14.686)

Present Tier Classification: 1

Comments: The site is labeled as “T1 progressing,” which means it shows some developments from the last inspection but may not suggest a complete shift to T2 (i.e., it can be considered a T1.5 site, although ODOT does not have a 1.5 tier class)

The site is located along route 265 and is shown in figure 7. We can observe slight cracking at the base of the slope and a series of thin (< 0.25 in) transverse cracks across the road. Water ponding was also present.

Figure 7 Photos of site visit for site LS00007054 (GUE-265-14.686).

7. LS00006361 (BEL-147-3.434)

Present Tier Classification: 1

Comments: T1 (Low/low) since 2012 and changed to T1 (Mod/low) in 2023 (possibly due to potential movement, without affecting the road)

This site is located along route 147. Trees and a power transmission pole have a slight lean. Slight soil slumping is present around a small culvert at side of road. Otherwise, landslide activity is not apparent.

Figure 8 Photos of site visit for LS0000636 (BEL-147-3.434).

8. LS00006360 (BEL-147-2.770)

Present Tier Classification: 2

Comments: T1 since 2012, moved to T2 in 2023.

This site is at the east end of a series of 4 slides along route 147. The site was recently moved from T1 class to T2 by Terracon, however, there was no sign of movement on the day we visited, so it is questionable why they moved it to T2. There are some longitudinal cracks present that may not be attributed to landslide movement, however, these cracks were quite wide at the time of the last inspection done by Terracon. There was also some evidence of seepage near the slope base.

Figure 9 Photos of site for site LS00006360 (BEL-147-2.770).

9. **LS00005045 (BEL-147-2.845)**

Present Tier Classification: 1

Comments: T1 since 2012; note of possible remediation

This was the second from the east in a series of 4 slides along route 147. There was no indication of landslide activity, aside from some slightly tilted trees. ODOT commented on the possibility that the road may have been previously damaged by oil and gas trucks that frequent the route but may have been recently fixed by the oil and gas companies.

Figure 9 Photos of site visit for site LS00005045 (BEL-147-2.770).

10. **LS00010617 (BEL-147-2.903)**

Present Tier Classification: 2

Comments: The site was lowered from T3 to T2 by Terracon.

This was the third from the east in a series of 4 slides along route 147. Our team walked by this site but did not notice any obvious landslide movement. No photos were taken.

11. LS00009556 (BEL-147-2.957)

Present Tier Classification: 2

Comments: The site has been T2 since 2012, and recently assigned “progressing” status.

This was the westernmost in a series of 4 slides along route 147 that were observed. The bending of the guard rail can be observed at the site as shown in Figure 11. Five borings were taken by ODOT along the roadway, and an inclinometer began taking readings about 1.5 years before this site visit.

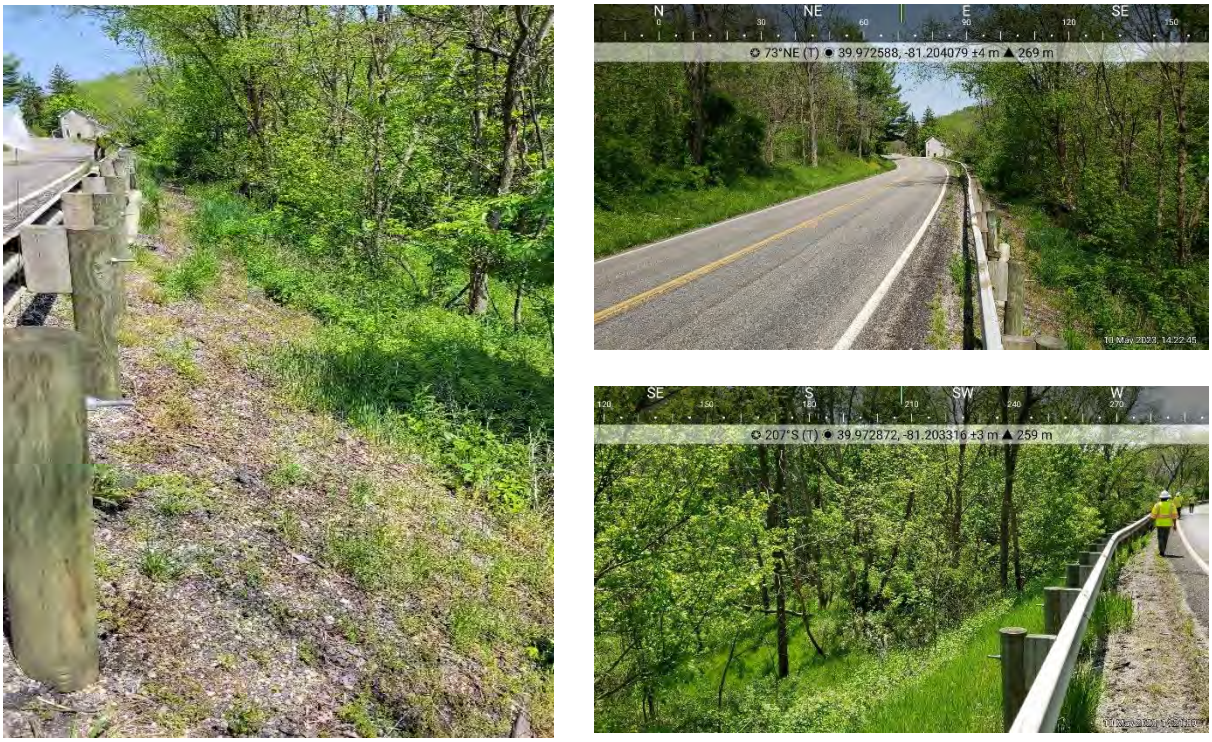


Figure 11 Photos of site visit for site LS00009556 **(**BEL-147-2.957).

12. LS00008935 (BEL-147-1.994)

Present Tier Classification: 2

Comments: Assign progressing status in 2023.

Figure 12 shows the site location near BEL-147.1.994, there was no sign of active landslide movement. Photos from 2013 available in the Falcon app suggest a significant network of pavement cracking that may have been recently covered .up. Other 2013 data suggests a bulge is visible in an area that is now covered with tall grass

Figure 12 Photos of site visit for site LS00008935 (BEL-147.1.994).

13. LS00009082 (GUE-513-3.265)

Present Tier classification: 3

Comments: Site was designated as T1 during past inspections in 2008 and 2018. Recently moved to T3 after this site visit with increased in landslide length.

The site shows widespread cracking in the pavement due to landslide movement, there is clear subsidence of the road observed. The head scarp along the road extends roughly 100 ft, and most damaged section exhibits a 2.5” vertical drop and 2” wide crack. Figure 13 shows the site location and developed cracks in the pavements.

The outer bank of a stream meander at the base of the slope appears to align with the landslide extent, indicating the possibility of stream-driven erosion contributing to the slide. Trees are also tilting in the direction of slide movement.

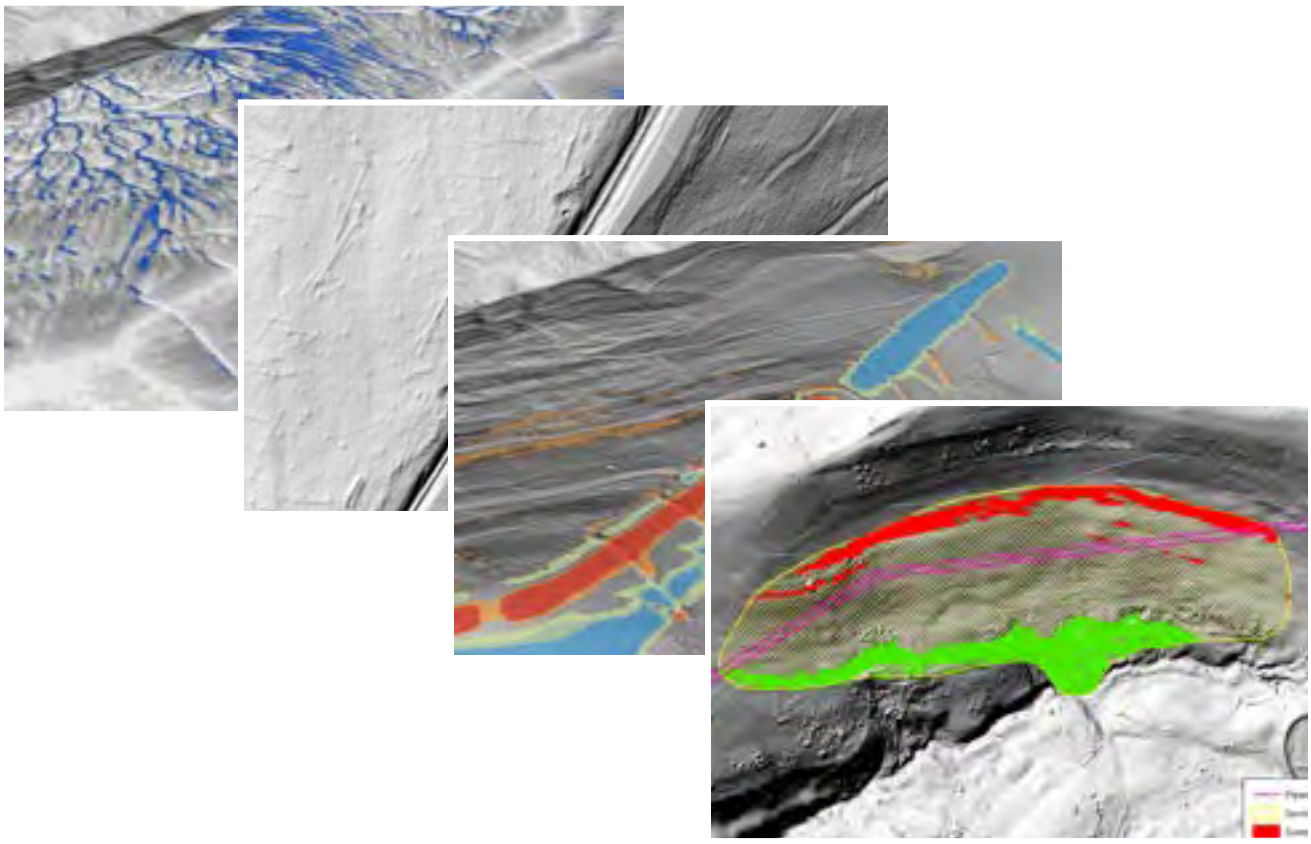
Figure 13 Photos of site visit for site LS00009082 (GUE-513-3.265).

APPENDIX C:

RESOURCES FROM TEREN (LIDAR)

- Hand-off document
- Data dictionary
- Presentation: Geohazard change detection utilizing lidar and advanced analytics
- Viewer quick start guide
- Attribute table for geohazard polygons
- Attribute table for change detection polygons

<Customer>
PROJECT



WELCOME

We at Teren are pleased to present <Customer> with a compilation of support documentation to help users understand and derive maximum value from their <Project Name>.

We suggest beginning with this document, which describes each analytic product. Then, for a deeper dive into the data, please reference accompanying documents including the Data Tour, and Data Dictionary. We welcome any questions or suggestions that may arise along the way.

This document is organized into the following sections:

1. Executive Summary
2. Analytics Definition

EXECUTIVE SUMMARY

Project History

TBD if we need this…

Project Scope

The scope of this project included aerial LiDAR data collection, processing, and analytics of the <project name>.

The deliverables in the first data delivery include:

- Analytics 1
- Analytics 2

Other relevant project milestones here.

ANALYTICS DEFINITIONS

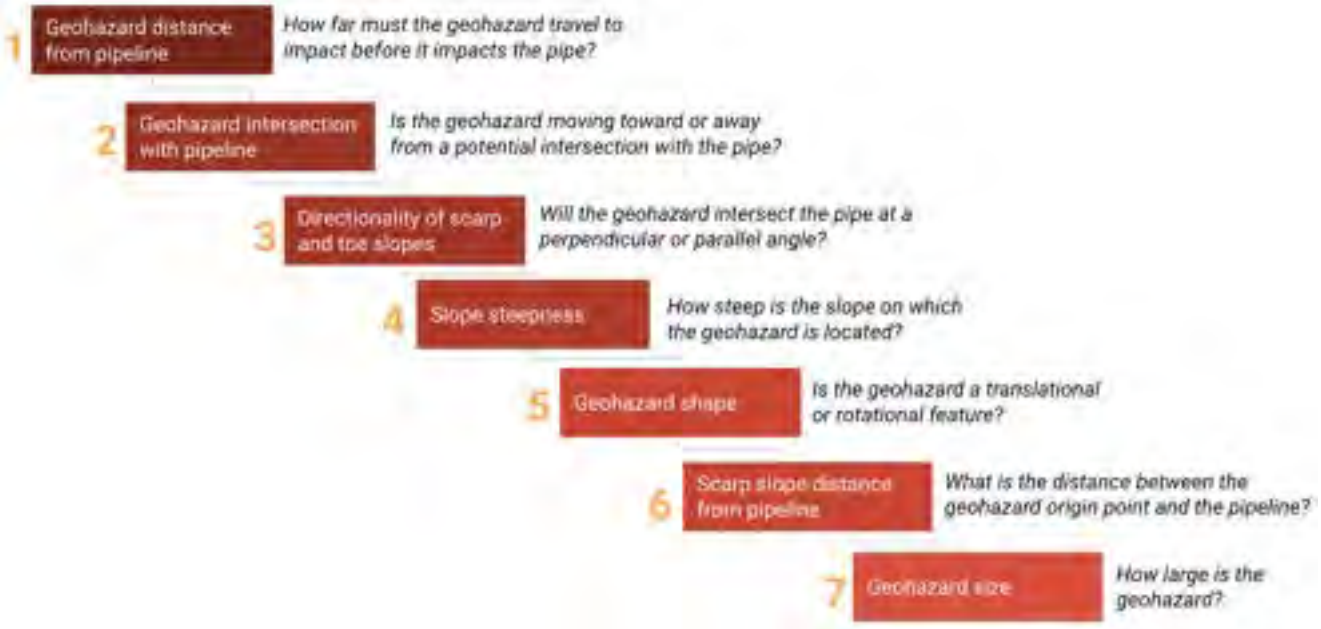
PRODUCT OVERVIEW

Geohazard Analytics

The Geohazard Analytics package consists of several deliverables to aid operators in identifying, predicting, and prioritizing geohazard threats.

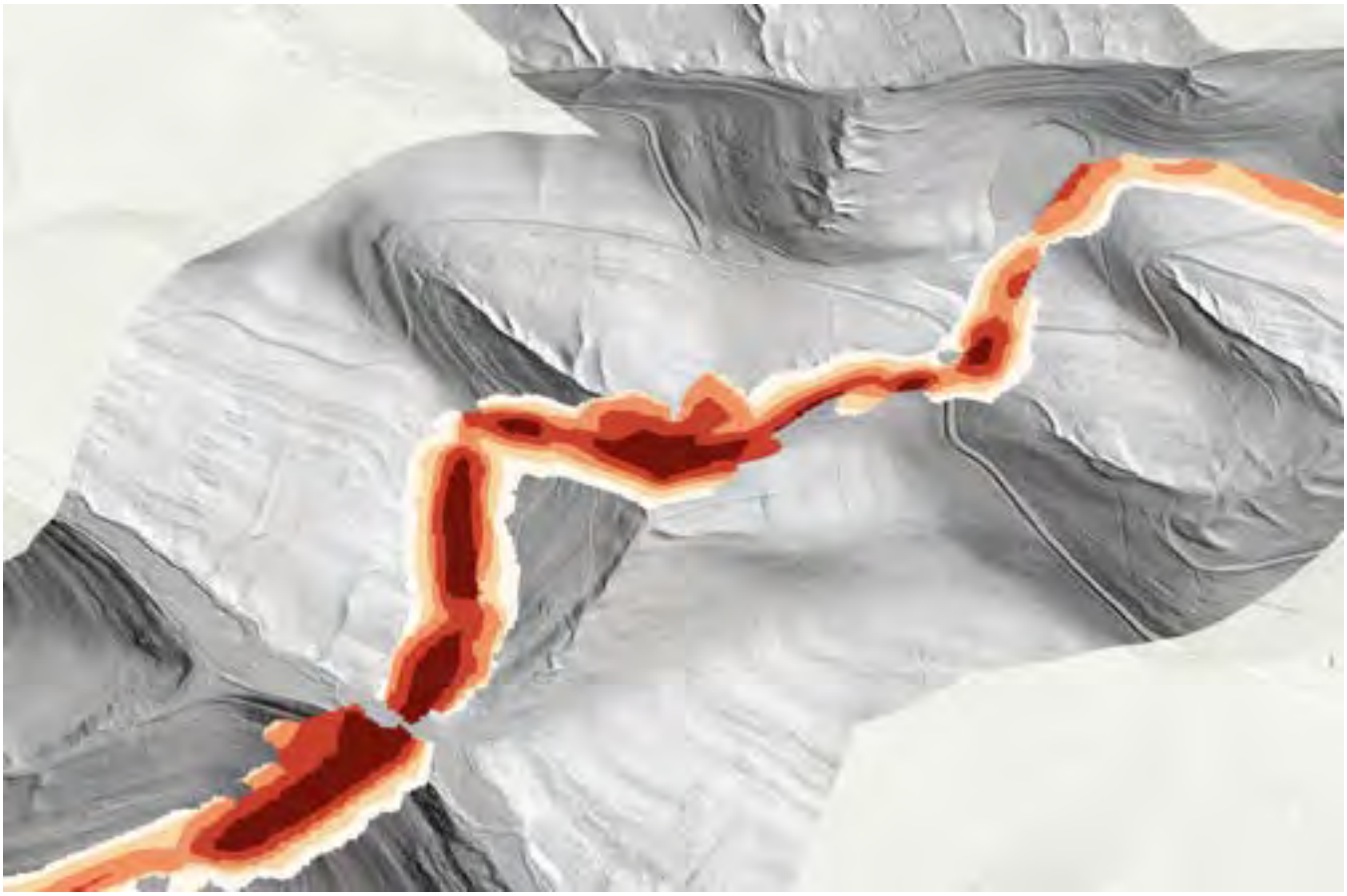
Existing Geohazards. The Geohazards analytic draws upon computer vision algorithms to detect existing landslides within and near the right of way with the potential to threaten asset integrity. Teren's algorithms then delineate each landslide's structural components, including the toe and scarp slopes. Taking into account landslide structure, situation within the terrain, connectivity to the asset, and other risk factors, Teren performs an Absolute Geohazard Assessment, whereby each geohazard's risk factors and absolute score are measured over time to understand changing risk conditions. Each geohazard is also assigned a relative ranking based on the threat it poses to the pipeline relative to all other identified geohazards.

Teren's Absolute Geohazard Assessment scores individual geohazards according to factors defined in the below model decision tree. An absolute score of 6 and above indicates that the geohazard intersects with the pipe centerline. An absolute score of 5 or below indicates that the geohazard is adjacent to but not intersecting the centerline.



In addition to evaluating changes in existing geohazards, Teren also reports the successful mitigation and emergence of geohazards. Fixed geohazards include landslides that were present in Spring 2021 and absent in Fall 2021 data. New geohazards include landslides that were absent in Spring 2021 and present in Fall 2021 data.

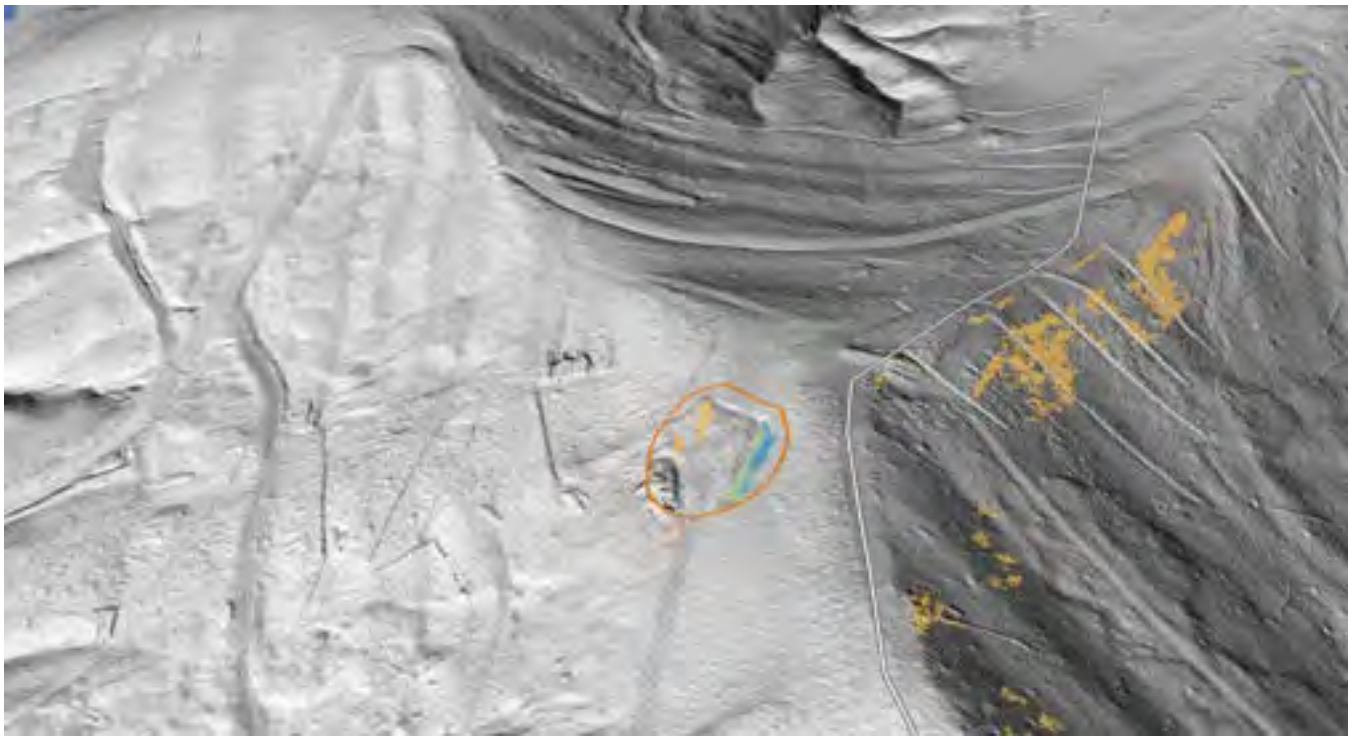
Problematic Hillslopes. In addition to delineating and ranking existing geohazards, Teren's Problematic Hillslopes analytic predicts the hillslopes throughout the pipeline system that are most likely to fail and compromise asset integrity. Considering factors such as slope, orientation, soil type, and hydrology, each hillslope connected to the pipeline is delineated and ranked according to its level of threat. Raster-based results empower efficient prioritization of proactive monitoring efforts and minimize surprise incidents.



Centerline Risk. The relative level of threat posed by existing geohazards and problematic hillslopes is summarized to the pipeline in three-meter segments and averaged based on a sliding mile to create the Centerline Risk analytic.

Change Detection Analytic

The Change Detection Analytic enables operators to understand terrain changes on their right of way through time.

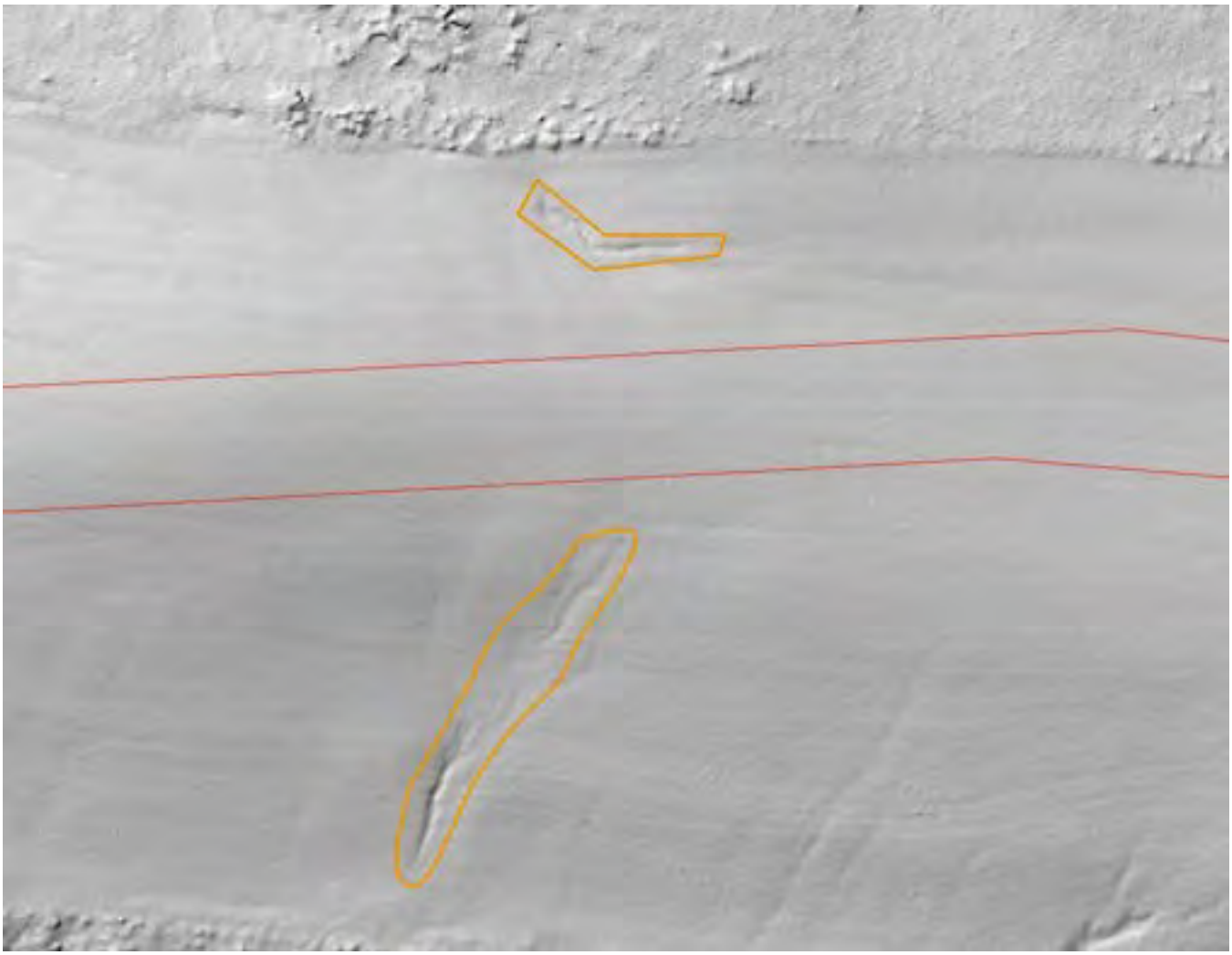


Continuous Change Detection. Teren's Continuous Change Detection analytic compares landscape features and terrain between two temporal datasets to detect subtle landform or surface structural changes. The algorithm first removes vegetation and elevation biases from the two temporal datasets under comparison. Then, the analytic measures vertical shifts greater than 1 foot within 60 feet of the centerline. The resulting deliverable is a raster heatmap of natural- and human-triggered material loss, subsidence, accumulation, and other movements that have occurred between Spring 2021 and Fall 2021 flight instances.

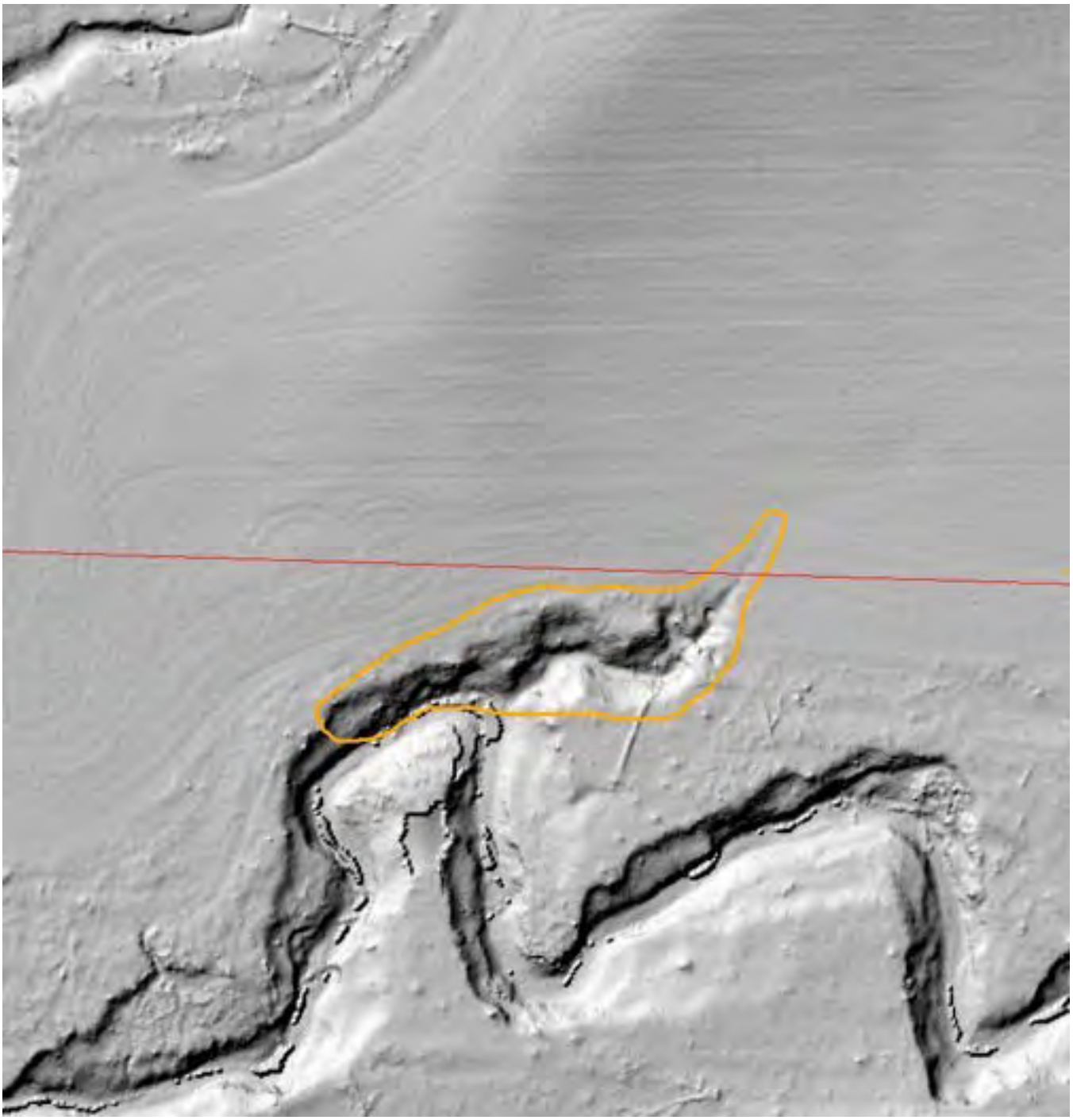
Geohazard Analytics

In topographically flat regions, geohazards manifest where hydrologic forces alter the landscape in ways that threaten asset integrity. Teren identifies and delineates the following geohazards to enable targeted monitoring and mitigation where needed most.

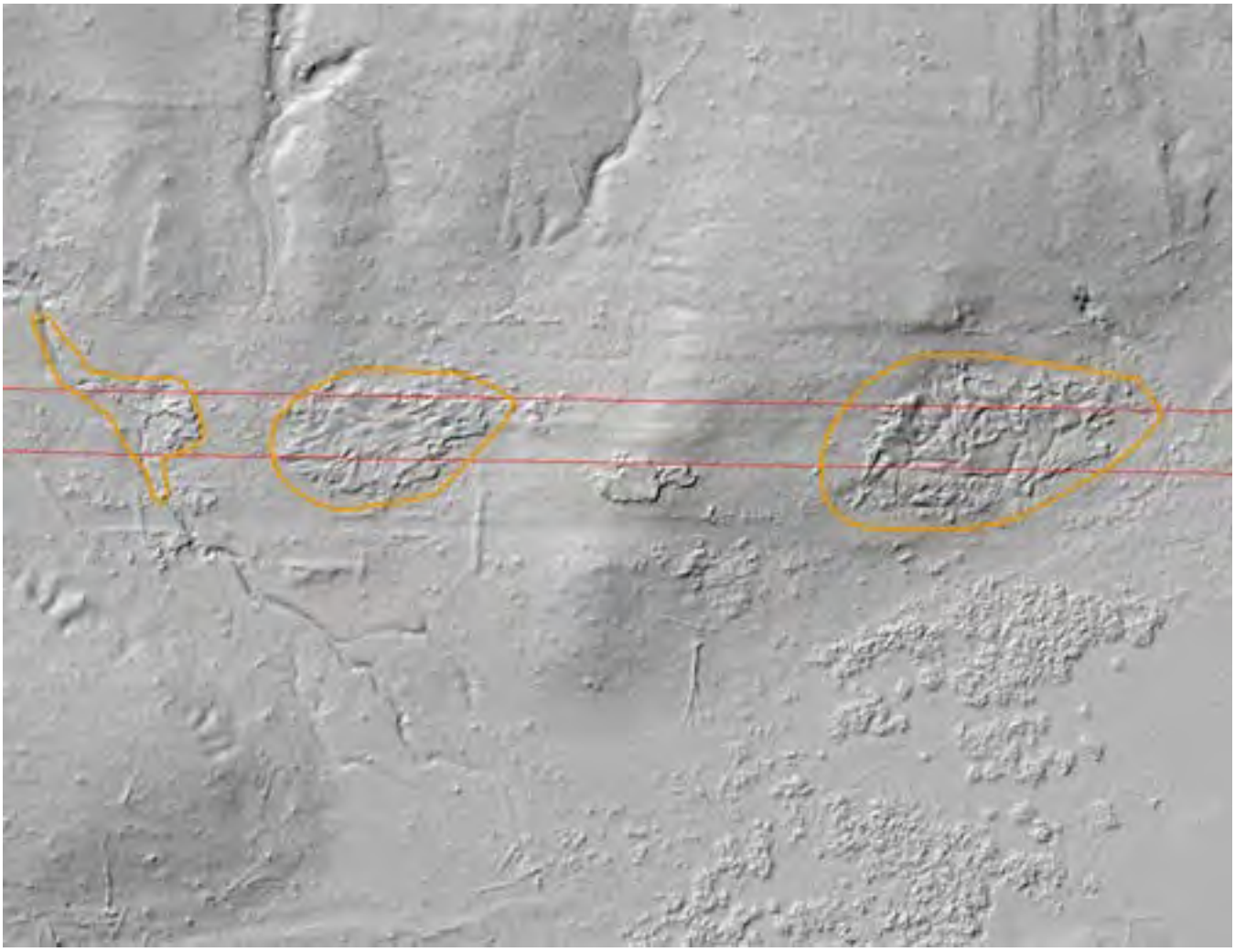
Cutbank. Teren's geohazard analytics identifies cutbank hazards which occur where a stream or river is eroding away on the outside bank of a curve in the water channel and the erosion is progressing toward the pipeline.



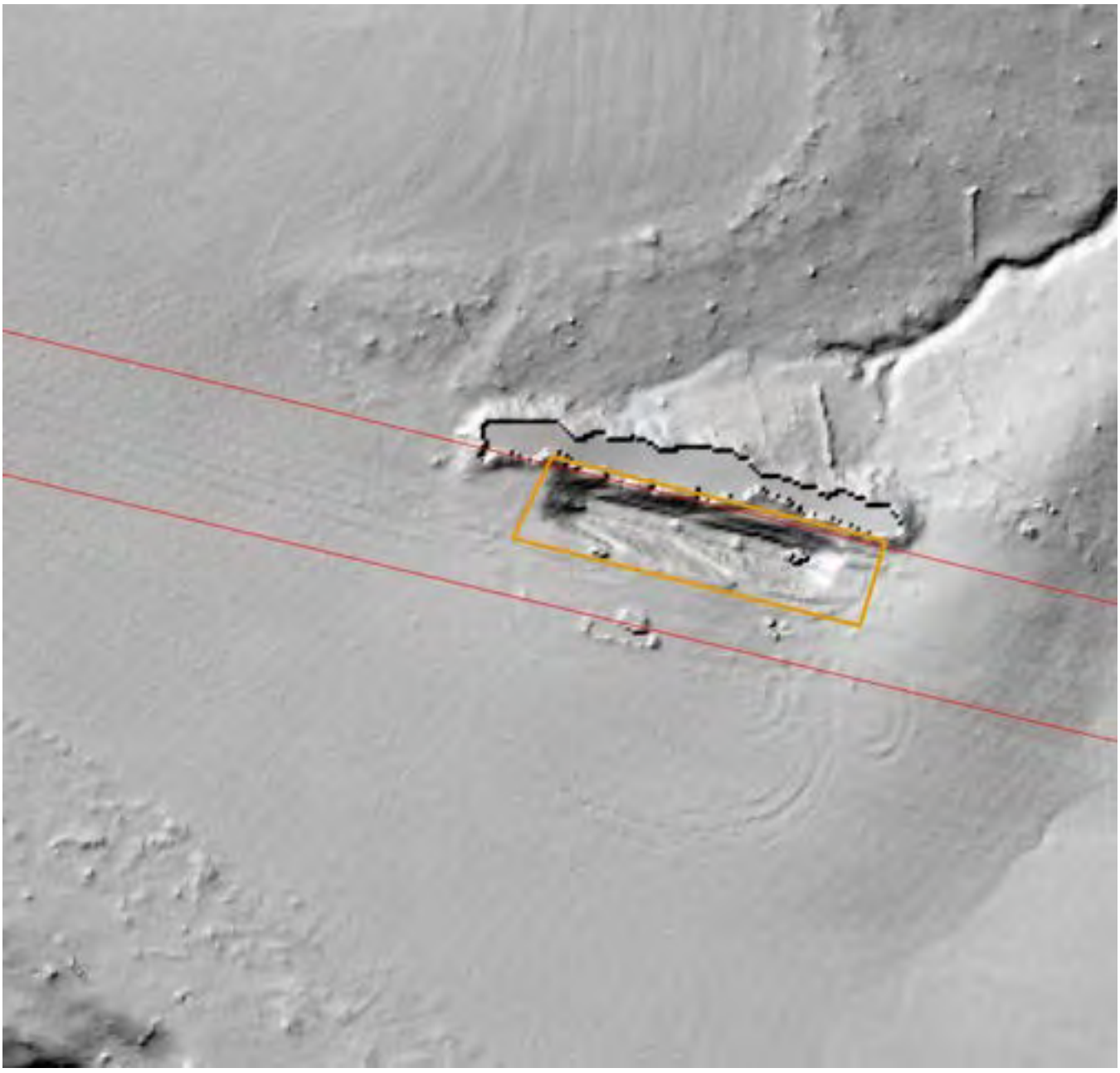
Rilling and gullying. Teren's geohazard analytic identifies rill hazards which form as small hydrologic channels that, if left unmanaged, can erode into a larger gully hazard with increasingly greater erosive potential.



Headcut. Teren's geohazard analytic identifies headcut hazards which are the most headward or upstream feature of a gully where active erosion and entrenchment occurs.



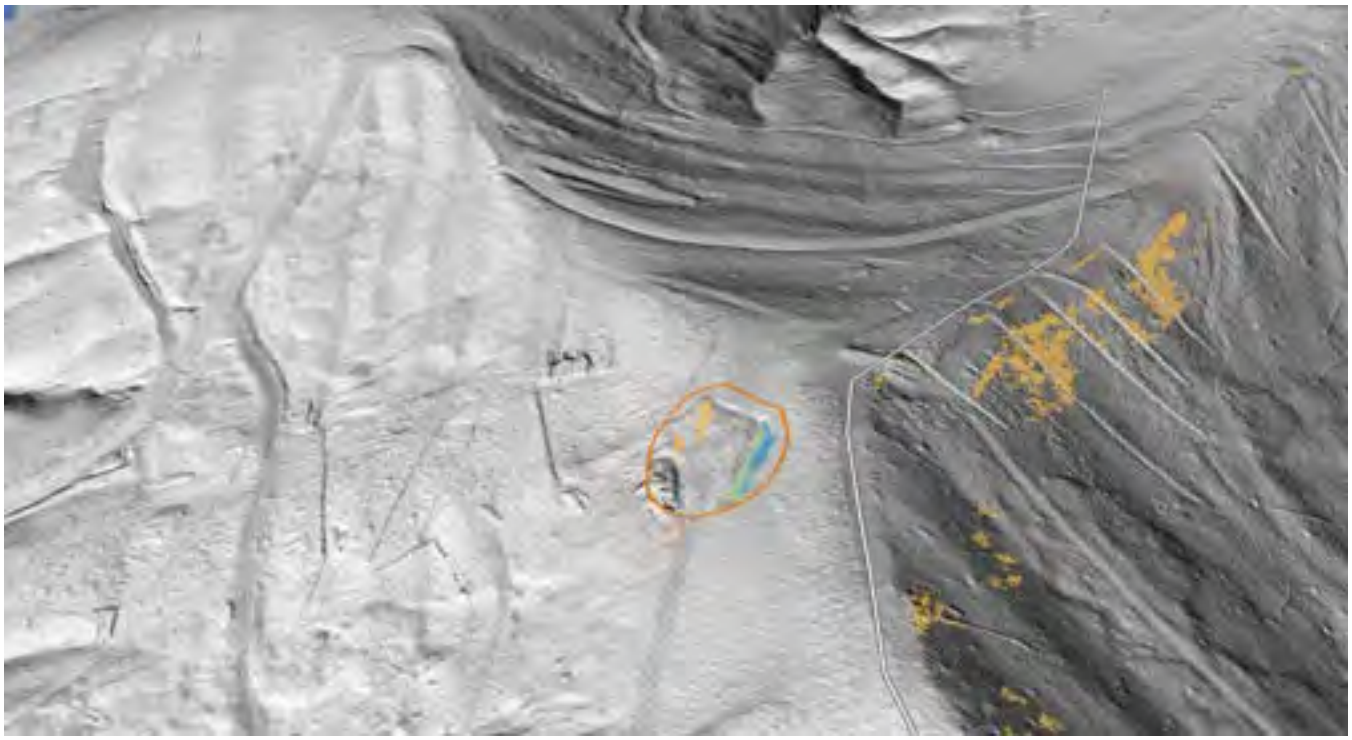
Saturated zone. Teren's geohazard analytic identifies saturated zones which occur where the terrain appears to be affected or altered by hydrologic inundation.



Exposed pipe. Teren's geohazard analytic identifies exposed pipe hazards which occur where the pipeline is visible above ground.

Change Detection Analytic

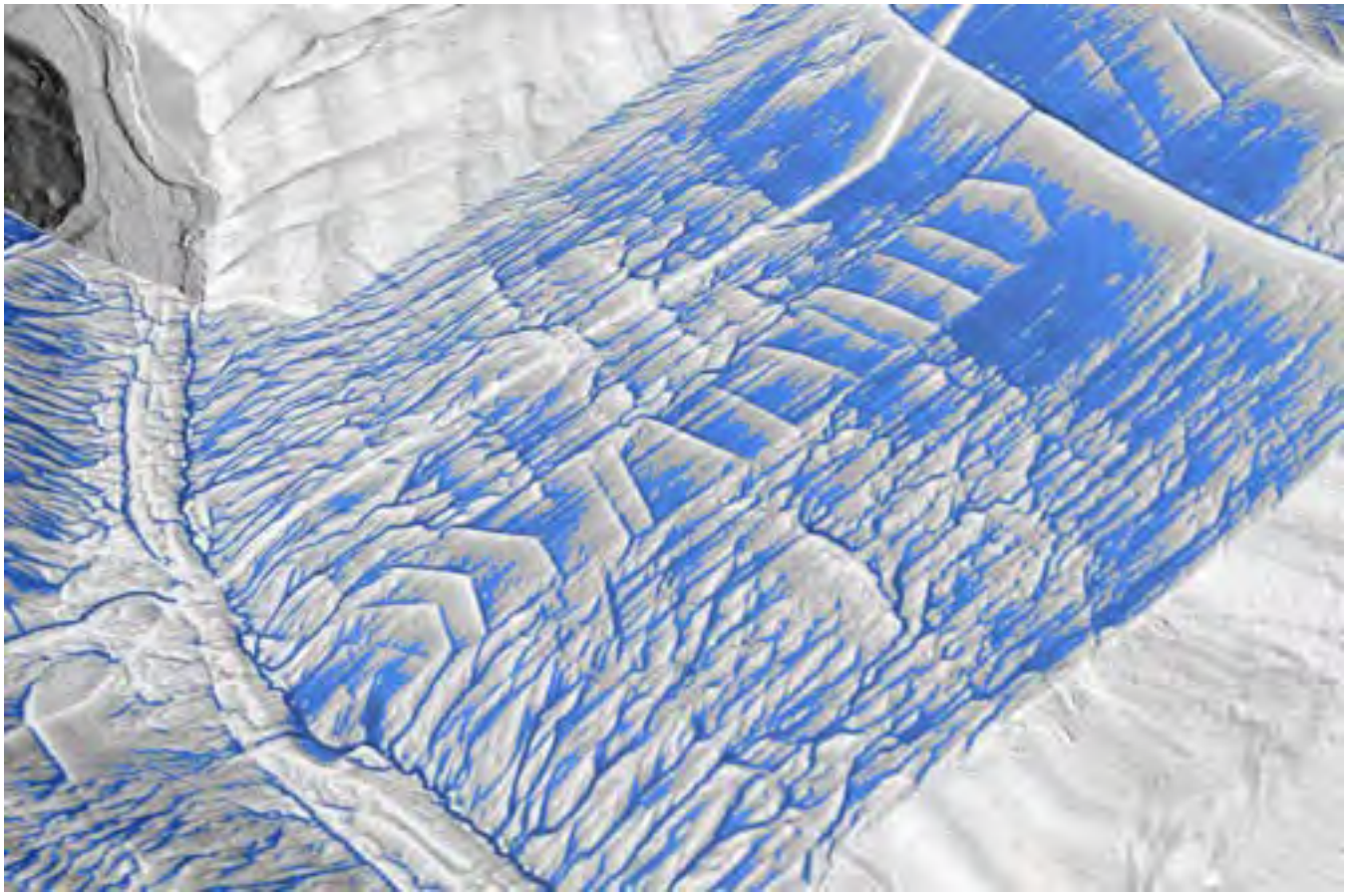
The Change Detection Analytic enables operators to understand terrain changes on their right of way through time.



Continuous Change Detection. Teren's Continuous Change Detection analytic compares landscape features and terrain between two temporal datasets to detect subtle landform or surface structural changes. The algorithm first removes vegetation and elevation biases from the two temporal datasets under comparison. Then, the analytic measures vertical shifts greater than 1 foot within 60 feet of the centerline. The resulting deliverable is a raster heatmap of natural- and human-triggered material loss, subsidence, accumulation, and other movements that have occurred between Spring 2021 and Fall 2021 flight instances.

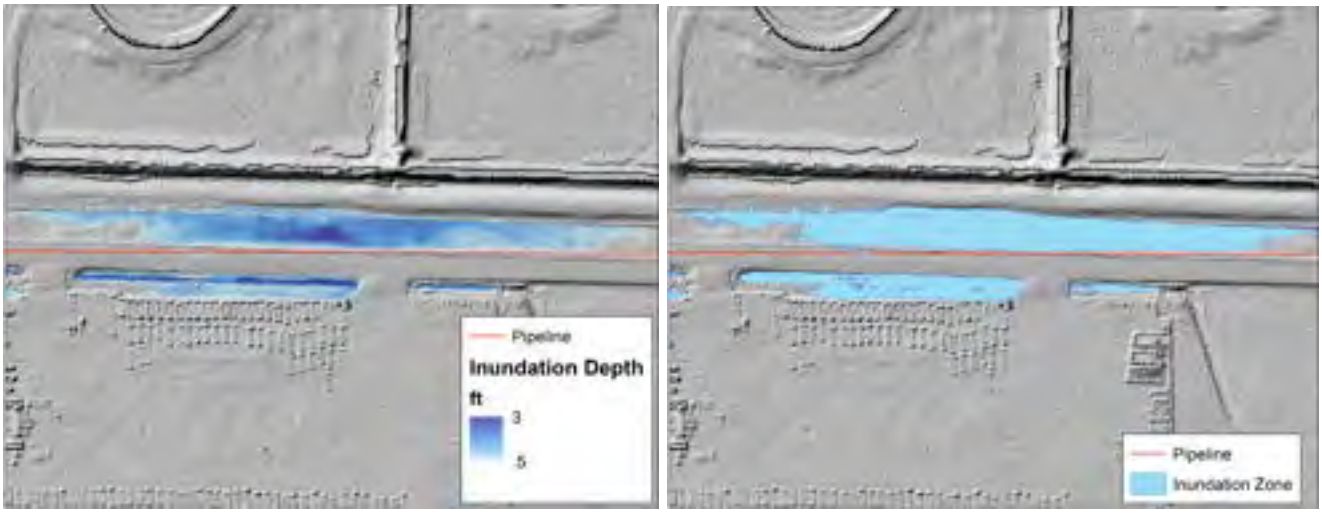
Hydrology Analytics

Assessing geohazards provides valuable insight into asset integrity threats; however, geohazards often occur as a result of environmental influences such as hydrology. The Hydrology Analytics package consists of two analytics to aid operators in identifying the root cause of land movement threats, enabling efficient and proactive mitigation activities prior to geohazard formation.



Problematic Hydrology. Teren's proprietary Problematic Hydrology analytic accurately models overland flow paths and quantifies the hydrologic energy moving across a right of way. The analytic reveals functioning or failing waterbars along with saturation and erosion zones.

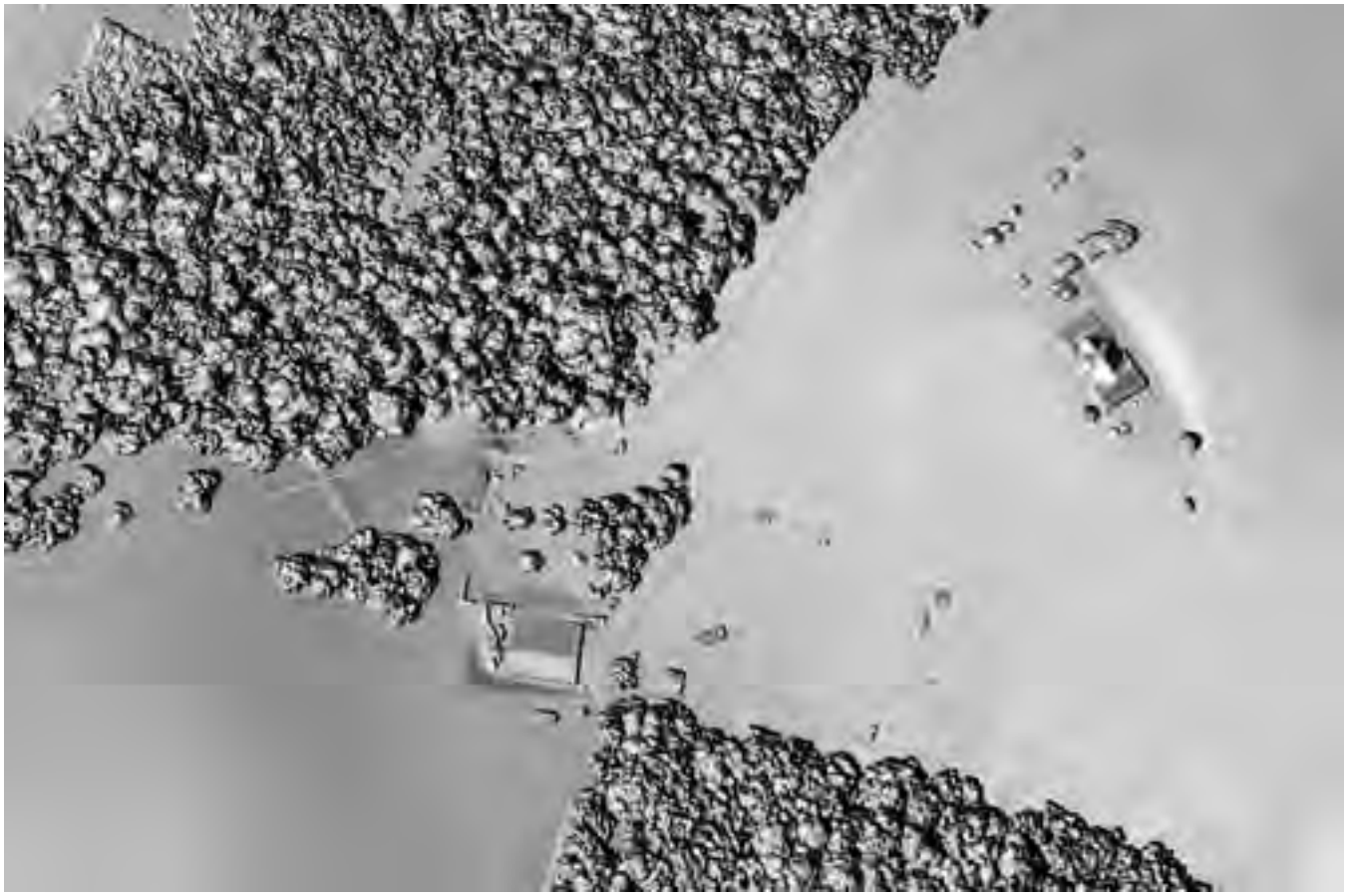
Flow Paths. After modeling continuous overland flow, Teren identifies where surface hydrology is most likely to erode or overwater the right of way, endangering slope stability and asset integrity. The Flow Paths analytic models each flow path's hydrologic energy, distance from the pipeline, and direction to assess potential impact to slope stability and asset integrity. The visualized results are limited to only those flowpaths deemed potentially threatening to asset integrity and enable precision placement of stormwater and erosion control devices.



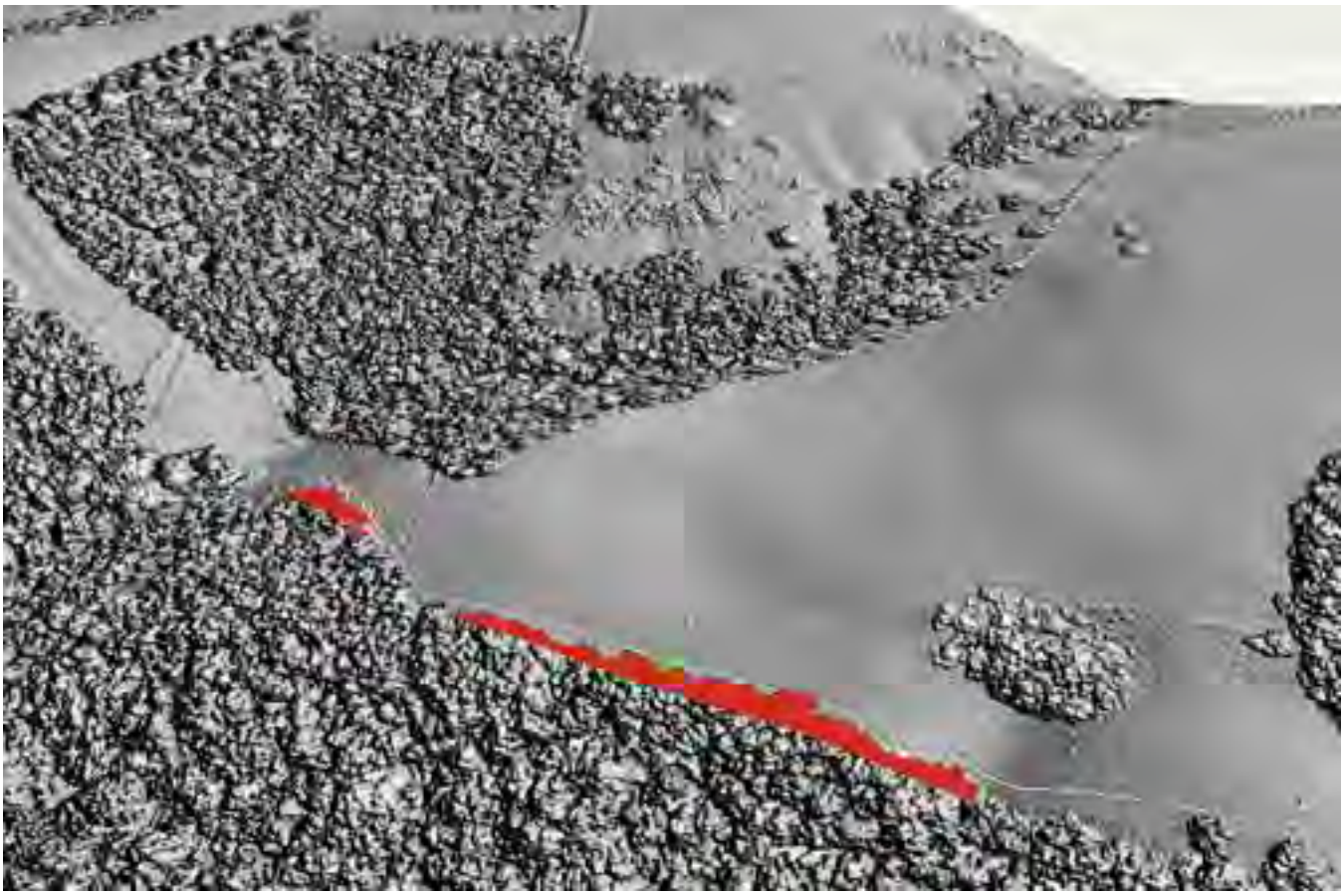
Inundation. Teren analyzes terrain data to identify closed basins, playas, flats, or low-lying areas where water accumulates and drains vertically through the soil profile, thus saturating the soil and increasing the likelihood of soil movement or subsidence. The inundation analytic identifies inundation zones within 60 feet of the pipe centerline where accumulation of greater than 10 cubic feet of water occurs.

Encroachment Analytics

The Encroachment Analytics package consists of two analytics to aid operators in identifying building and vegetation encroachment threats along the right of way with potential implications for asset integrity and regulatory compliance.



Buildings. Teren's Building analytic executes machine learning algorithms to detect surface variability in the terrain data and identify vertical and horizontal hard edges within the landscape that form the polygon of a building footprint within 1,000 feet on either side of the centerline. The model detects building footprints at or greater than 200 square feet.



Vegetation. The Vegetation analytic depicts where woody vegetation intersects the pipe centerline, thus inhibiting regulatory compliance and effective aerial patrol.

This document supports users in understanding the geospatial data layers and attributes associated with Fall 2022 RoW Integrity Management.

Layer Group	Layer	Layer Description	Attribute	Attribute Description
Encroachment	Veg_mgt_zone	Layer depicts woody vegetation encroachment zones with corresponding average distance-to-pipeline, volume, height, and encroachment threat, in addition to structure variability.	N/A	N/A
Hydrology	Flow_paths	Layer depicts the potential stream flow channels along the surface, incorporating slope and length to identify potential problem areas.	fp_risk	Hydrologic risk score assigned to each flow path based on slope and length.
			net_risk	Risk score assigned to the network of flow paths based on slope steepness, slope length, and distal and proximal connectivity to the pipeline.
			fp_pct	Percentile ranking of flow path network risk to the pipeline.
	problematic_hydrology	Raster layer depicts continuous hydrologic surface flow over the RoW.	N/A	N/A
Hazards	Problem_hillslope	Summarized vector layer delineates and ranks hillslope stability threat zones to the pipeline based on landslide potential and hydrology.	CDF_MEAN	Percentile ranking of problematic hillslopes zones.
Hazards continued	Problem_hillslope_threats	Raster layer depicts continuous hillslope threat to the pipeline based on landslide potential and hydrology.	N/A	N/A
	Centerline_risk	Layer depicts the relative level of threat posed by problematic hillslopes and existing geohazards is summarized to the pipeline in three-meter segments and averaged based on a sliding mile.	CDF_MEAN	Percentile ranking of problematic hillslopes summarized to the pipeline in three-meter segments and averaged based on a sliding mile.
	Geohazards Fixed New	Layers depict a) the absolute risk score of individual geohazards and b) the relative threat each geohazard poses to the pipeline compared to all other identified geohazards. Geohazard absolute and relative risk scores are based on a unique combination of the risk factors represented as additional attributes within the layer. Fixed depicts geohazards that were present in Spring 2021 and absent in Fall 2021 data. New depicts geohazards that are present in Fall 2021 and absent in Spring 2021 data.	status	status of geohazard compared to previous collect.
			slope_deg	Average slope (degrees) of the hazard.
			aspect	Major aspect of the hazard.
			geoshape	Area/perimeter ratio of the hazard compared to a circle with the same area. A value closer to zero indicates a more irregular oval shape, while a value closer to one is more like a circle. This metric loosely classifies a landslide as a translational slide < ~.55 or a rotational slide > ~.55.
			scarpdist	Average distance (feet) of the scarp slope from the pipeline.
			scarpht	Average height (feet) of the scarp slope.
			scarpratio	Uphill intersect ratio of the scarp slope with the pipeline. A value of 0 indicates that the scarp slope is 100% below the pipeline, and a value of 100 indicates that the scarp slope is 100% above the pipeline.
			Scarpdir Scarpdir continued	Direction of the scarp slope from the pipeline based on the slope aspect. A value of 0 indicates that it is above and perpendicular to the pipeline; a value of 90 indicates that the scarp slope is parallel to the pipeline; a value of 180 indicates that it is perpendicular but below the pipeline.
			toeslpdis	Average distance (feet) of the toe slope from the pipeline.
Hazards continued			toeslprank	Uphill intersect ratio of the toe slope with the pipeline. A value of 0 indicates that it is 100% below the pipeline and a value of 100 indicates that the toe slope is 100% above the pipeline.

Hazards continued	Geohazards Fixed New continued		toeslpdir	Direction of the toe slope from the pipeline based on the slope aspect. A value of 0 indicates that it is above and perpendicular to the pipeline; a value of 90 indicates that the toe slope is parallel to the pipeline; a value of 180 indicates that it is perpendicular but below the pipeline.
			hydrology	Ratio between the area of the slide and the local watershed area connected to the slide. This value indicates how much hillslope area is above the slide.
			flow_dst	Hydrological distance (feet) of the slide from the pipeline. This metric indicates how far the slide would have to travel via hydrological processes before impacting the pipeline.
			eucdist	Straight-line distance (feet) of the hazard from the pipeline.
			impactang impactang continued	Direction that the slide is most likely going to interact with the pipeline. A value of 0 indicates that the uphill portion of the slide will impact the pipeline at a perpendicular angle; a value 90 indicates that the slide is running more parallel to the pipeline; and a value of 180 indicates that the slide is moving downslope and away from the pipeline.
			pipeInter	Amount that the uphill portion of the slide is intersecting the pipeline. A value of 0 indicates that the slide is 100% below the pipeline, and a value of 100 indicates that the slide is 100% above the pipeline.
			absrank	Absolute score (1-10) of geohazard threat based on unique combination of risk factors.
			ABS_con	Combination of risk factors contributing to the absolute risk score.
			relthreat	Threat the hazard poses to the pipeline relative to all other identified geohazards. This is a function of distance from the pipeline, impact angle, size, and hillslope steepness.
			relrank	Percentile ranking of the relative threat that the hazard poses to the pipeline compared to all other identified geohazards.
	Persistent	Layer depicts geohazards that were present in Spring 2021 (time 1) and Fall 2021 (time 2) data. Attributes highlight changes that have occurred between the two datasets.	t1_cnt	Number of time 1 geohazards that interact with the geohazard identified at time 2.
			t1_pa_ch	Percent change in area covered by geohazards between time 1 and time 2.
			t1_area_ch	Absolute change in area covered by geohazards between time 1 and time 2.
			t1_dist_ch	Change between time 1 and time 2 in the average distance of the geohazard from the pipeline.
			t1_int_ch	Change between time 1 and time 2 in the amount of intersection of the uphill portion of the geohazard with the pipeline.
			t1_ABS_ch	Change in absolute geohazard score between time 1 and time 2.
			t1_area	Area of a geohazard at time 1.
			t1_dist	Average distance of geohazard from pipeline at time 1.
			t1_inter	Amount that the uphill portion of the geohazard intersected the pipeline at time 1.
Hazards continued			t1_ABS_con	Combination of risk factors contributing to the absolute risk score.
Continuous Change	Continuous_Change	Raster layer depicts continuous change in surface elevation of the RoW greater than 1 foot between time 1 and time 2.	N/A	N/A

Continuous Change	Change_detection	Polygon layer that depicts and calculates the absolute change within a continuous change area	Sum	Abolsute value of change within the polygon.
Structures	Buildings	Vector layer depicting identified structures within 1000 feet on either side of the centerline.	N/A	N/A

TEREN

Geohazard Change Detection Utilizing LiDAR and Advanced Analytics

1

Agenda

A Closer Look at Geohazards

TEREN

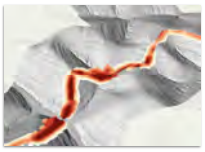
- Introduction/Overview
- Nationwide Threat & Susceptibility
- Geohazard Identification & Assessment & Prioritization
  - Methodology
  - Landslides & Erosion
  - Hillslope Threats
  - Hydrologic Modeling
  - Debris Flow Analysis
- Key Considerations
- Closing

1

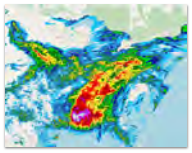
2

Asset Resilience Framework

Making the Leap from Risk to Resilience



PRIORITIZE
Identify and quantify distinct threats.



MONITOR
Monitor and respond to changing environmental conditions.

ASSESS
Identify threats and susceptibility across the entire asset footprint.

REPORT
Verify and report on improved resilience and reduced risks.

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3

TEREN

Nationwide Threat & Susceptibility

2

4

Essentials - Threat and Susceptability

Weather & Climate-Enhanced Geospatial Data

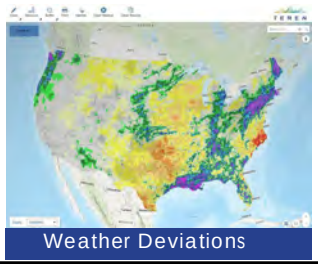
Climate-Enhanced Data + Powerful Processing

- Curated Analytic Layers
  - Considers temperature, precipitation, etc.
  - Proprietary soils and hydrology data
  - Built by industry experts
- High-Performance Computing for Speed & Scale
  - Analytics for the entire system & nationwide

Threat & Susceptibility Layers

Subsidence
Landslide
Road Erosion
Agriculture Erosion
Seismic
River Scour
Coastal & Inland Flooding
Wildfire Potential
Weather Summary

River Scour


Weather Deviations

Wildfire Threat

Depth of Cover

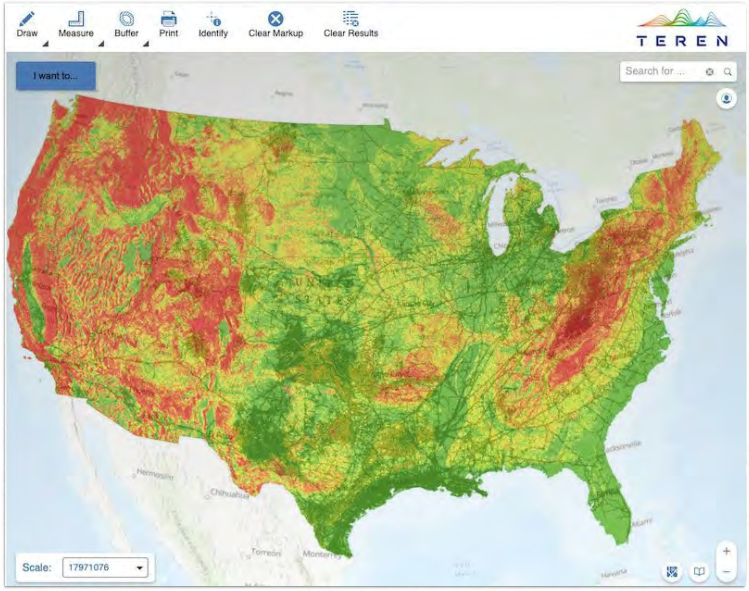
5

Landslide Threat

Climate-Enhanced Data Layer

Forward-Looking Model

- USGS Landslide
- Teren-Identified Landslides
- Environmental Triggers
- Landslide Potential Algorithm
- 10-meter Resolution
- Powered by HPC



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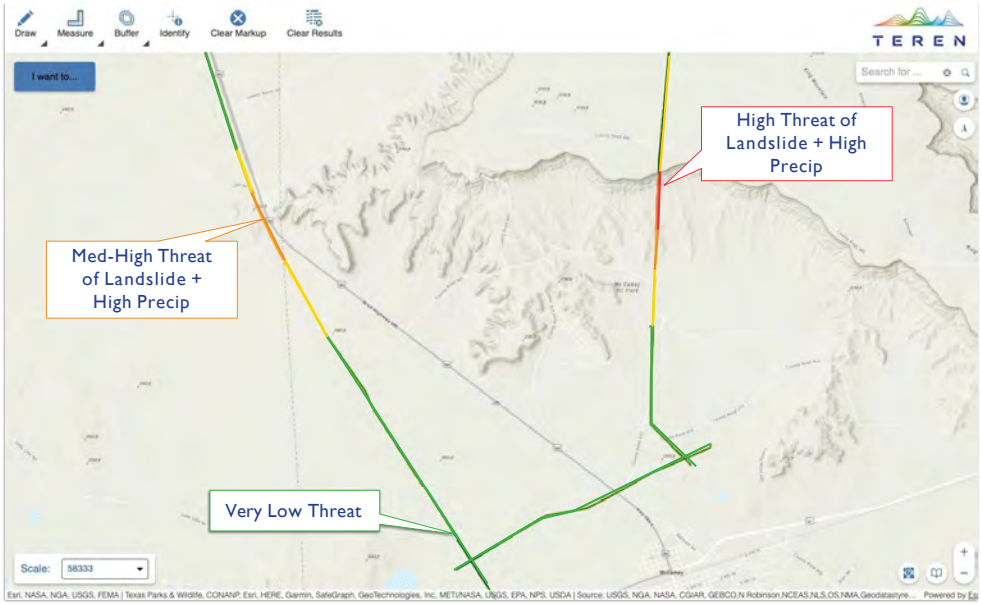
6

Essentials Output

Linear-Referenced Risk Summary



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7

Hillslope Stability Model

Mechanics of Earth Movement

$$HS = \frac{Resisting\ Forces\ (strength)}{Driving\ Forces\ (stress)} \longrightarrow HS = \frac{c+(\sigma)\tan\Phi}{\tau} \longrightarrow HS = \frac{c+\Upsilon H\ cos^2\ \Theta \tan\Phi}{\Upsilon H \cos\Theta \sin\Theta}$$

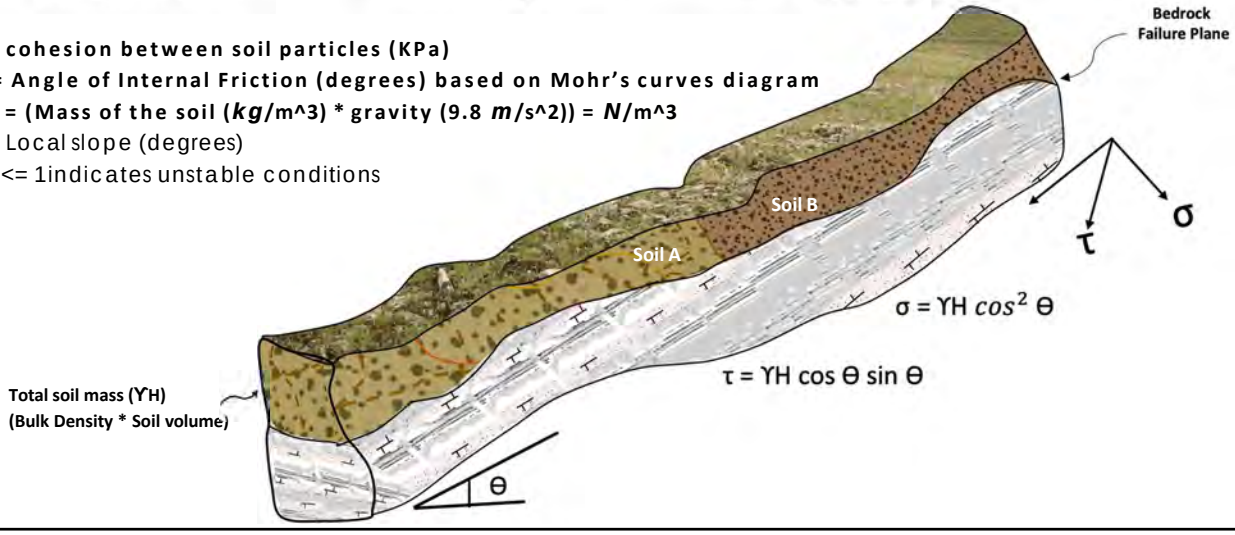
C = cohesion between soil particles (KPa)

Φ = Angle of Internal Friction (degrees) based on Mohr's curves diagram

ΥH = (Mass of the soil (kg/m^3) * gravity (9.8 m/s^2)) = N/m^3

Θ = Local slope (degrees)

HS <= 1indicates unstable conditions



8

Landslide Potential

Mechanics of Earth Movement

Development of explanatory variables (Terrain and soils information)

- Slope (Degrees)
- Hillslope Curvature
- Hillslope Surface Hydrology
- Hillslope position
- Hillslope Length
- Generalized soil properties
  - Liquid limit
  - Permeability
  - Bulk Density

Development training dataset

- USGS documented landslide (13,800)
- SolSpec documented landslide (900)
- 75 percent observations as training
- 25 percent observation as validation

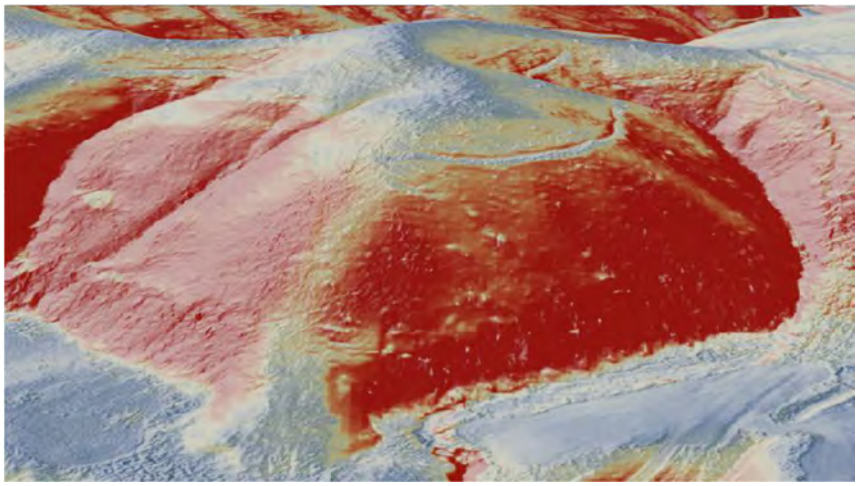
Development landslide probability statistical model

- Random Forest approach

Validate model using validation dataset

- 80 percent accuracy rate

Convert statistical model into landslide probability raster



9

Hillslope Threats

Where are Our Greatest Risks?

The relative level of threat posed by problematic hillslopes and existing geohazards is summarized to the centerline in three-meter segments using a sliding mile analysis.

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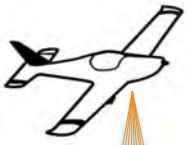
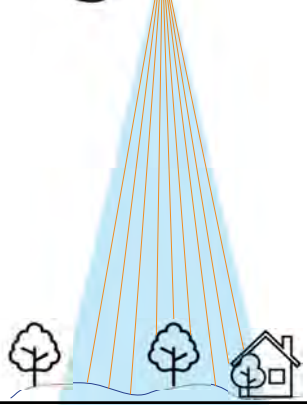
10

Acquisition Techniques

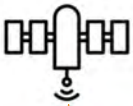
Drones
Tech: 3-4 band
Resolution: 3-5 cm
Accuracy: +/- 2-4m

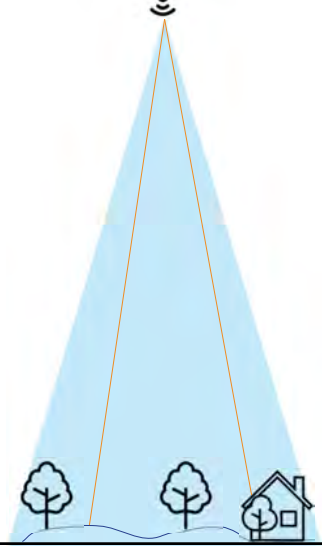
LiDAR + Aerial
Tech: LiDAR, 4-band
Resolution: 3-5 cm, 20 ppm
Accuracy: +/- 5 cm





Commercial Satellite
Tech: 3-8 band, InSAR
Resolution: 50 cm to 20m
Accuracy: +/- 2-4m, Noisy





11

Processed Sensor Data

Topography

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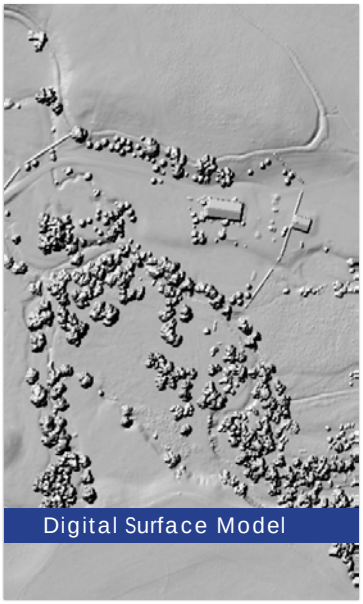

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Geohazard Identification

Geohazard Detection & Ranking: Landslide

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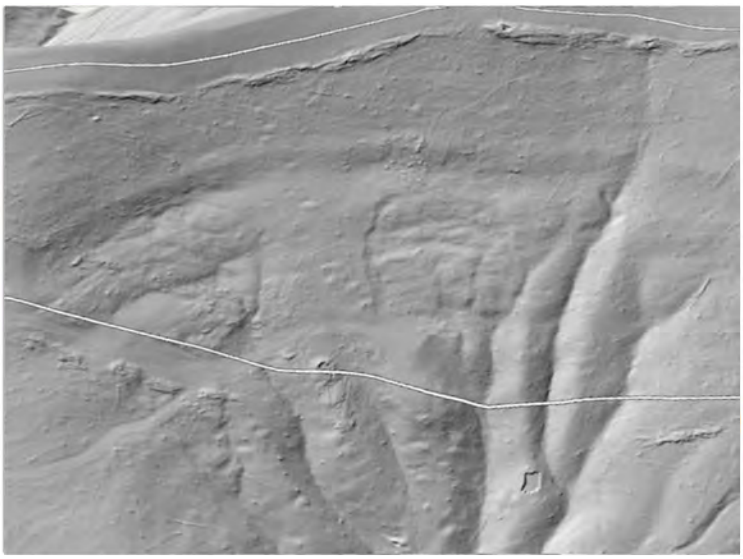
Geohazard Assessment

Geohazard Detection & Ranking



Geohazard Detection

- Derived from terrain analysis to identify and delineate boundaries.

Rule based hazard ranking system

- Asses physical characteristics
  - Morphology
  - Hillslope steepness
  - Hydrology
- Asses asset hazard characteristics
  - Distance
    - Straight line
    - Flow path
  - Movement
    - Towards or along or away
  - Adjacencies
    - Morphological Intersects
- Reporting and prioritization
  - Characteristic reporting & prioritization score (1 to 10)

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Geohazard Assessment

Geohazard Detection & Ranking

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1. **Geohazard distance from pipeline** — *How far must the geohazard travel to impact before it impacts the pipe?*
2. **Geohazard intersection with pipeline** — *Is the geohazard moving toward or away from a potential intersection with the pipe?*
3. **Directionality of scarp and toe slopes** — *Will the geohazard intersect the pipe at a perpendicular or parallel angle?*
4. **Slope steepness** — *How steep is the slope on which the geohazard is located?*
5. **Geohazard shape** — *Is the geohazard a translational or rotational feature?*
6. **Scarp slope distance from pipeline** — *What is the distance between the geohazard origin point and the pipeline?*
7. **Geohazard size** — *How large is the geohazard?*

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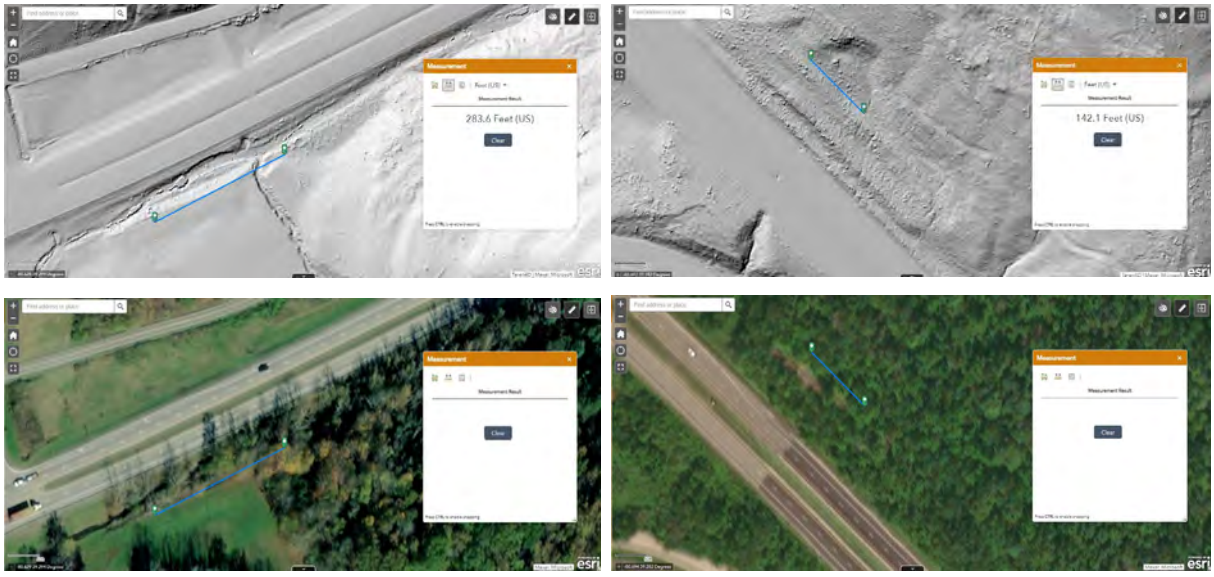
OH DOT Potential Geohazards

Identifying Potential Hazards Near Highway



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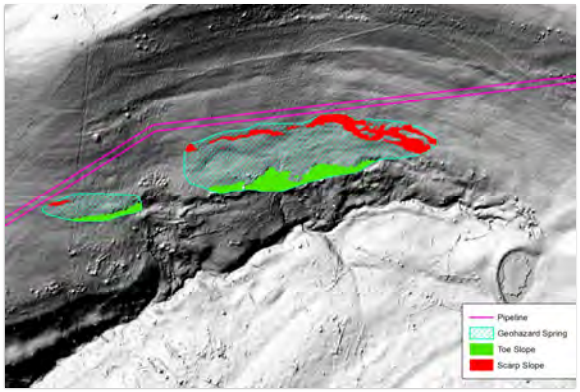
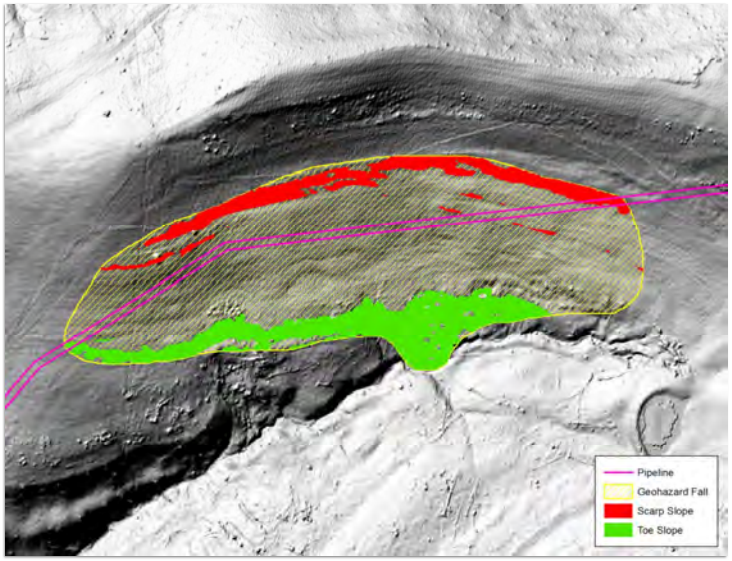
Geohazard Monitoring and Reporting

Change Detection

Measurement of geohazard structure enables precision understanding of how geohazard risk determinants change over time.



Spring 2020



Fall 2020

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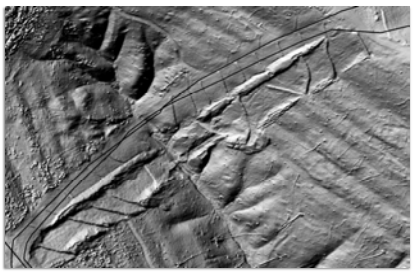
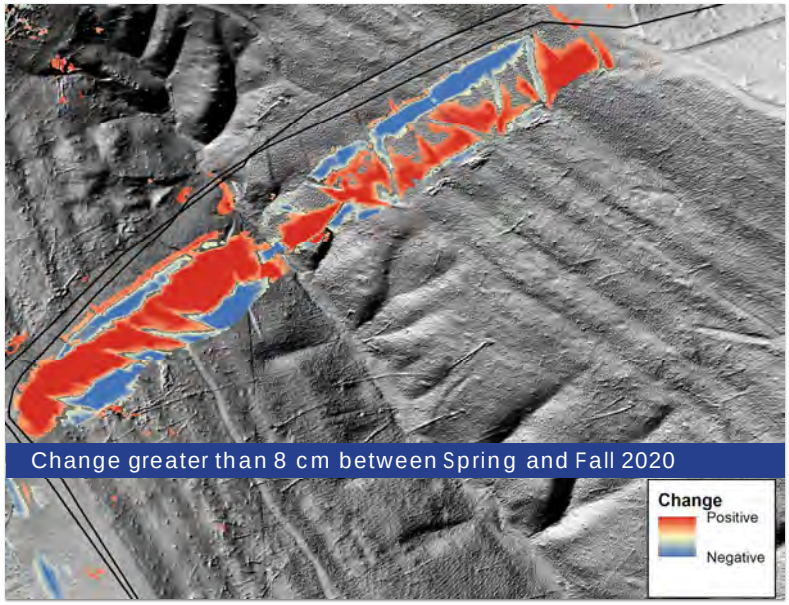
Measuring Growth Over Time

Continuous Change Detection



Spring 2020 Hillshade

Fall 2020 Hillshade



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Hydrology Analysis

Geohazards

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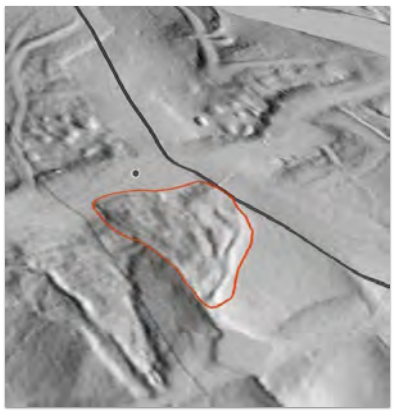
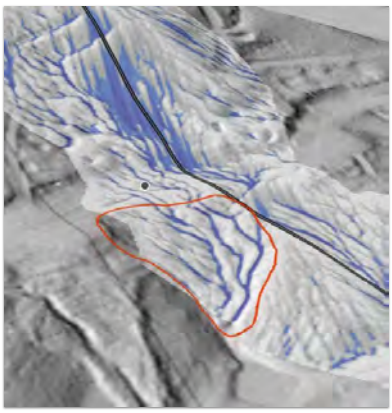
Hydrology Analytics reveal underlying flowpaths contributing to geohazard development and inform precision installation of stormwater controls.

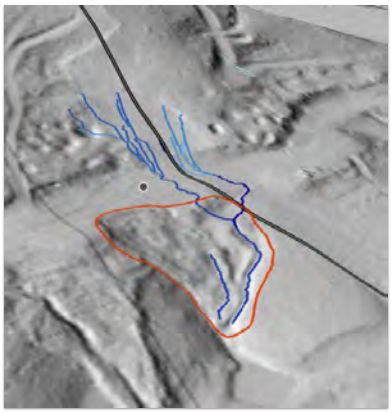
Identified Geohazard



Surface Hydrology



Problematic Flowpaths



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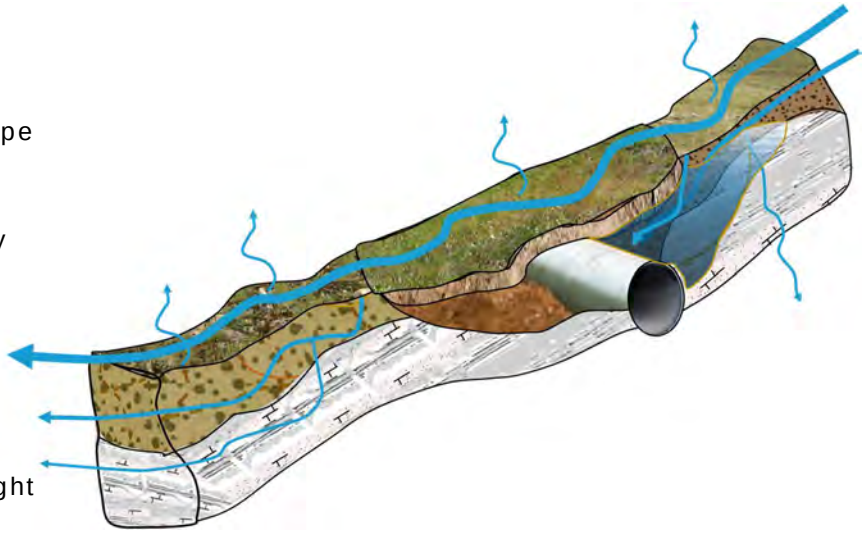
Hydrology Modeling

Mechanics of Earth Movement

Hillslope <u>Most</u> At Risk

Lower AIF and Cohesion (i.e., slope stability) due to:

- Increased soil moisture
- Less evapotranspiration by trees
- Area of disturbance
- Tree root removal
- No root channels to move water to ground
- Dam caused by pipe and trench, also increases weight and pore pressure



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Hydrology Analysis

Failing Water Bars

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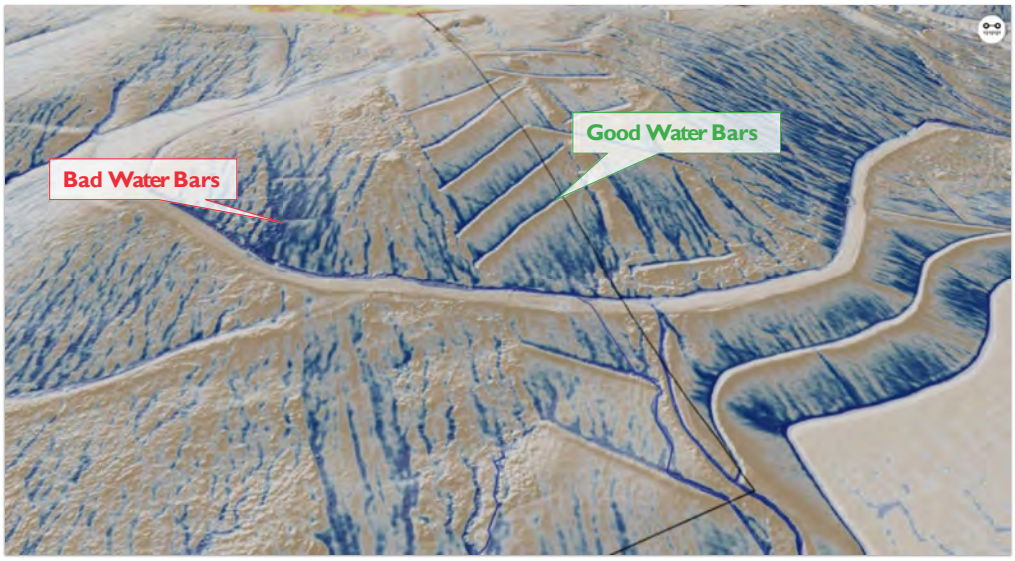

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Large Scale Assessment

Appalachian Region Data Stats

20,000 mi sq	Acquired, processed, catalogued, indexed, and served to major pipeline operators
6,000+ threats	Classified, quantified, tracked, and reported
4,500+ miles	Pipeline right-of-way currently managed through Teren's Pipeline 4D

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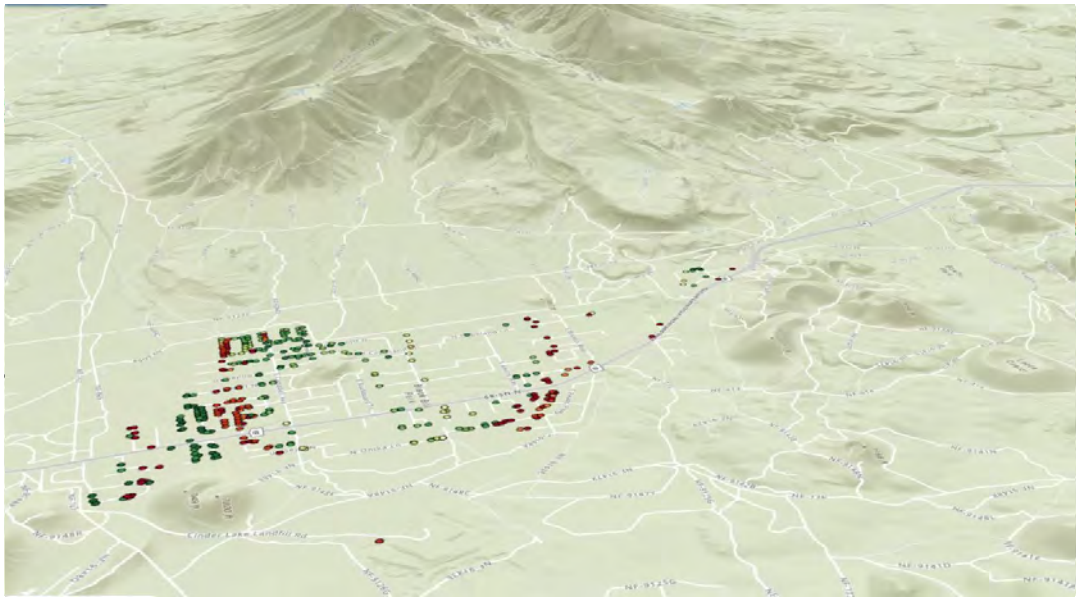
FEMA Debris Flow Analysis Pipeline Fire, AZ

Burn Severity, Debris Flow and Real Time Climate Integration



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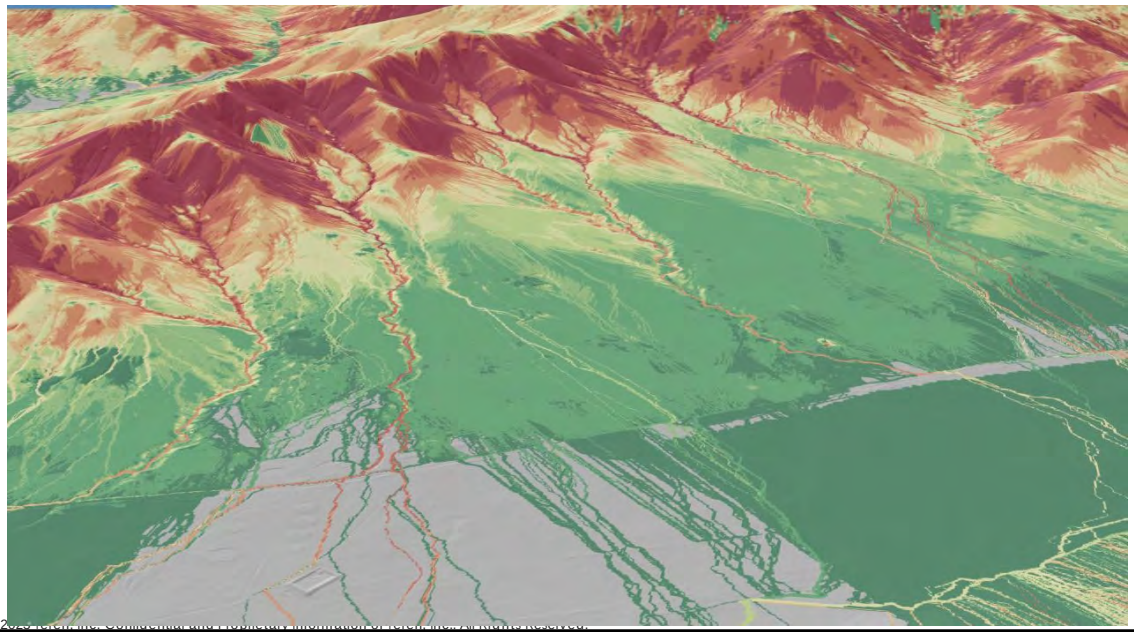
Hermit's Peak Post-Wildfire Analytics

Terrain, Hydrology, Debris Flow, Sedimentation, Optimal Stabilization, Tree Harvesting, and Permissions Tracking



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Summary

A Closer Look at Geohazards

TEREN

- Teren is providing a platform and framework for assessing risk and building asset resilience over time at scale
- Teren leverages its earth movement mechanics expertise with AI/ML and HPC technologies
- Teren provides the temporal and spatial relevance to geohazard identification, prioritization and monitoring
- Nationwide analytics for broad scale susceptibility assessments and prioritizations of asset threat

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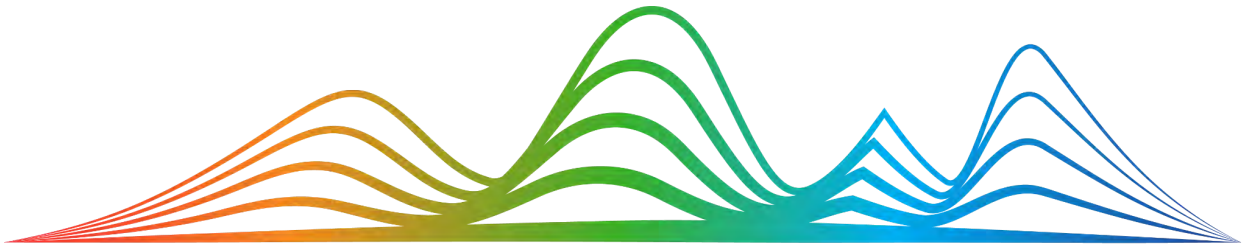

TEREN

Viewer Quick Start Guide

Version 1.0

February 2022

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Introduction

Teren is pleased to present our next-generation web map experience. The Teren Viewer provides a plethora of tools for viewing, querying, analyzing, and working with the data provided through the Right-of-Way Integrity Management program. This viewer has been designed to work like many of the web mapping viewers on the market today with the intention of supporting ease of use.

The Teren Viewer is an extensible enterprise platform that will rapidly grow in functionality, with several additional features launching in the next few months.

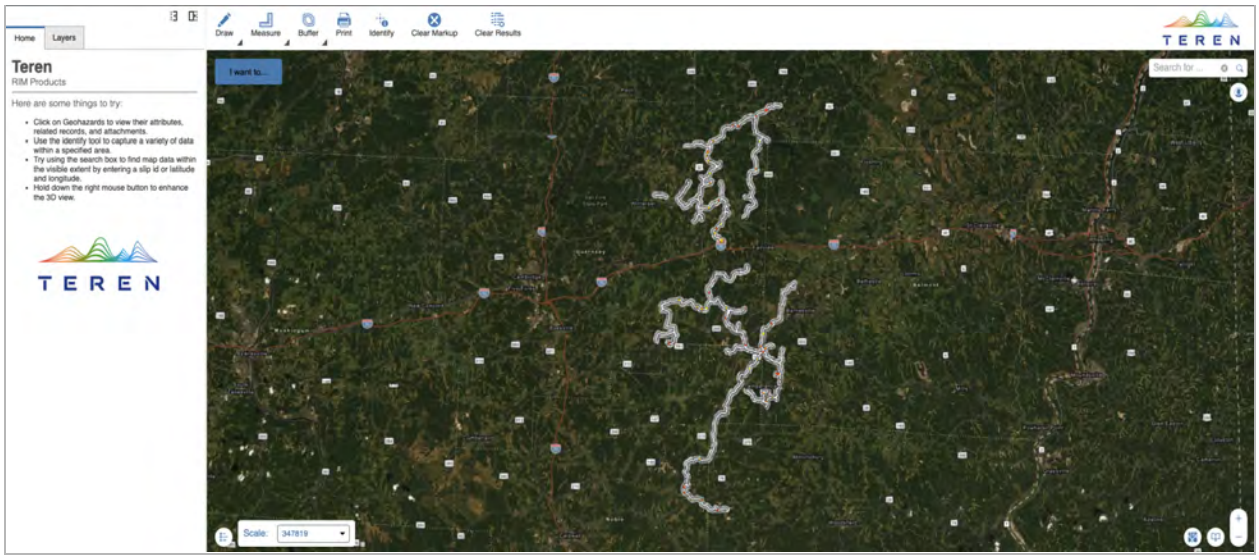
At Teren, user experience is at the forefront of our priorities, and we welcome your feedback and suggestions for features that could improve or enhance your experience with the Teren Viewer. If you have questions, feedback, or suggestions for our team, please contact support@solspec.io.

This *Quick Start Guide* is intended to help users become familiar with the Teren Viewer while we work toward the release of more in-depth user support documentation. The Teren Viewer *Quick Start Guide* will be updated to reflect new features as they are released.

Viewer Overview

The Teren Viewer enables you to interact 3-dimensionally with data, view data attributes, filter data, zoom to features, bookmark points of interest, and export results.

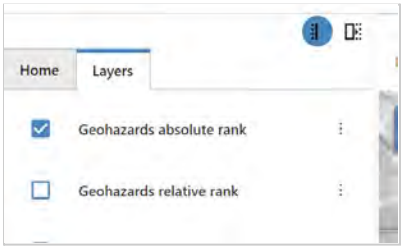
After logging into the Teren Viewer with your assigned credentials, you will see a home screen that includes the web map canvas, toolbar (at screen top), and panels (at screen left).



Panels

When the viewer is initially loaded, the panels appear on the left side of the screen. The panels provide a location to store descriptive information, manage the layers loaded in the webmap, and present other interactive mapping components.

Panels can be hidden, maximizing the map canvas space. In the top-right corner of the panel, highlight the **close panel** or **open panel** icons hide and show the panel (close panel highlighted in blue).



Home Panel

The Home Panel is reserved to store descriptive information to support engagement with the Viewer. New features will be added to this location.

Layers

The Layers tab provides a list of all layers loaded in the Web Pap.

Layer Visibility

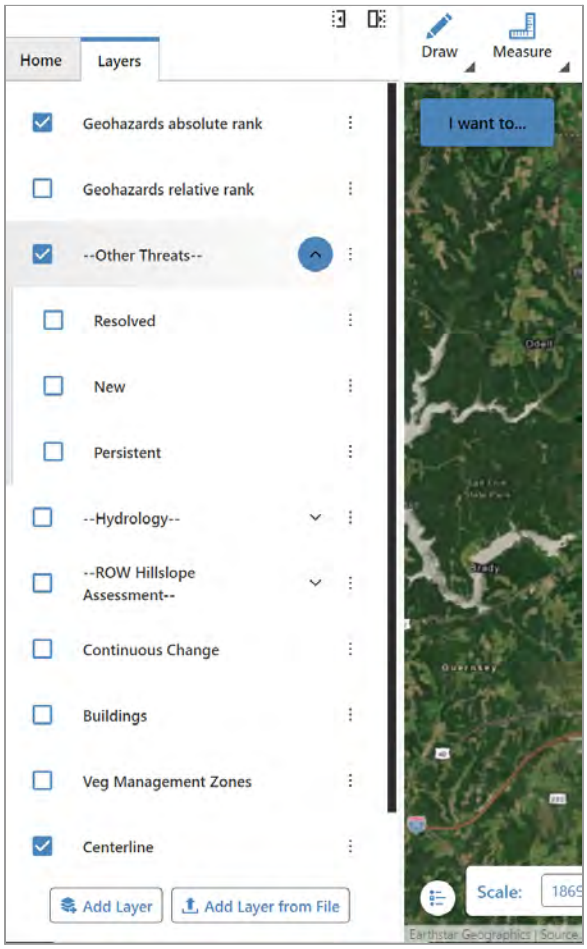
To make a layer visible, ensure the check mark is selected to the left of the layer.

Grouped Layers

To make the Layers list more organized, layers that share similarity are grouped into categories. These grouped layers are easy to find; the text begins with two dashes ("--") followed by a caret ("v" or "^") to the right of the text.

For example the Group Layer called "--Other Threats--" contains many Geohazards layers:

- Resolved
- New
- Persistent



To make any layer within a group of layers visible, ensure the check box to the left of the group layer is checked on.

To expand or contract a grouped layer click the caret (“v” or “^”) to the right of the grouped layer name.

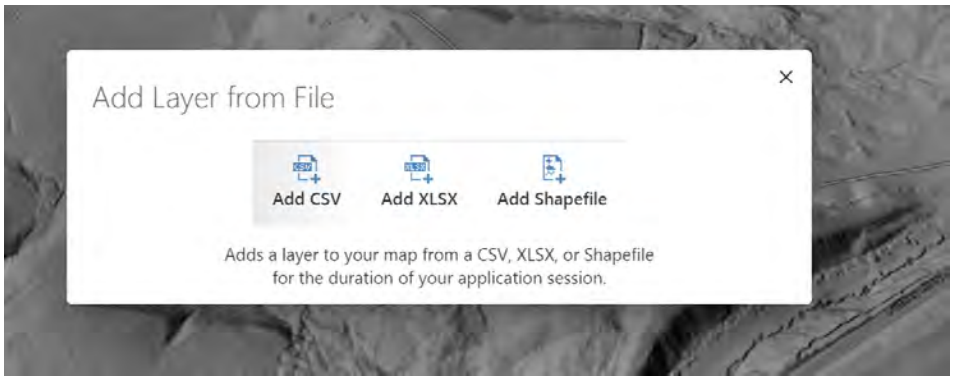
Add Layer

The Viewer environment allows you to load data from previous Right-of-Way Integrity Management acquisitions performed by Teren. Data for the most recent two acquisition and analysis periods will be available through the **Add Layer** menu option located at the bottom of the Layers Panel.

The **Add Layer** feature launches a window that provides visibility to previously loaded analysis results. The window supports search and filter capabilities, allowing you to refine the choices for layers to add to the map.

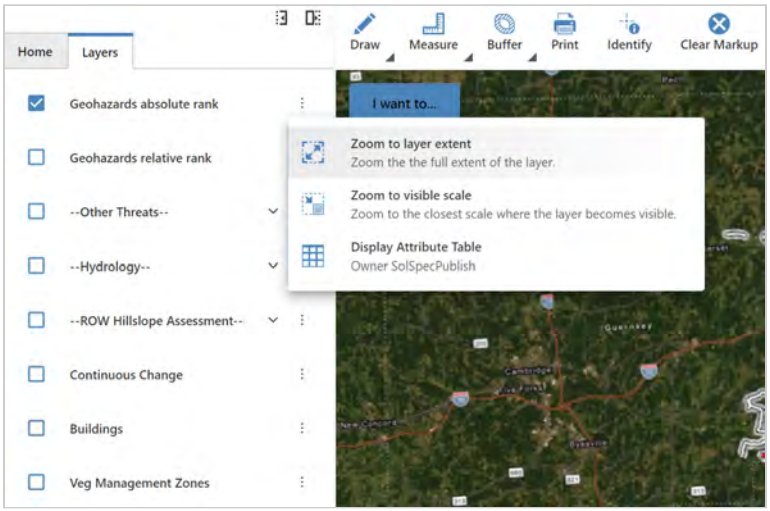
Add Layer from File

The **Add Layer from File** feature launches a dialog allowing you to upload files to the web environment. The .CSV and .XLSX options support the upload of point file formats. The Shapefile options supports the uploading of points, lines, and polygons. Note that all contents of the Shapefile must first be combined into a .ZIP file before uploading them to the Teren Viewer.



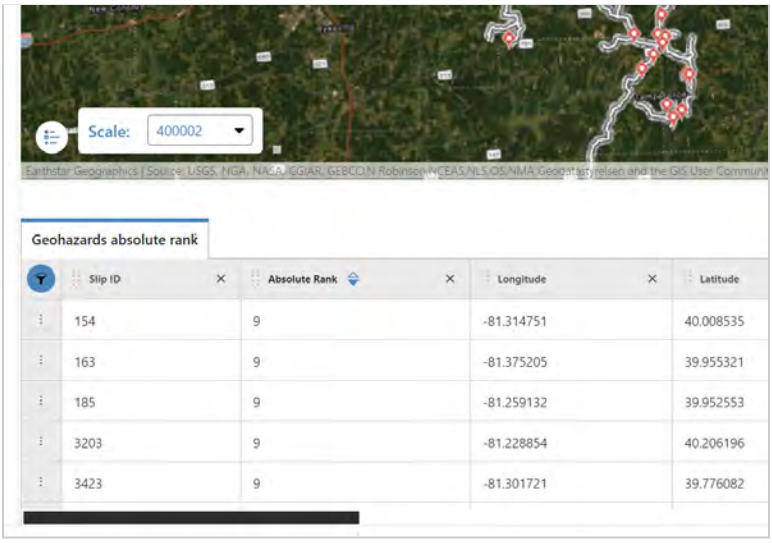
Attribute Table Display

Teren provides a plethora of valuable data with the Right-of-Way Integrity Management analytics suite. There are times when viewing, sorting, and filtering the tabular attribute data provides for valuable assessment of the results.



To open the attribute table for a layer, click the “3 dots” menu to the right of the layer name. Select **Display Attribute Table** from the menu. Note - only the “geohazards absolute/relative rank” have this feature

The table appears below the map canvas. Data can be sorted by clicking the up/down arrows at the top of the column header. (Clicking multiple times reverses the sort.)

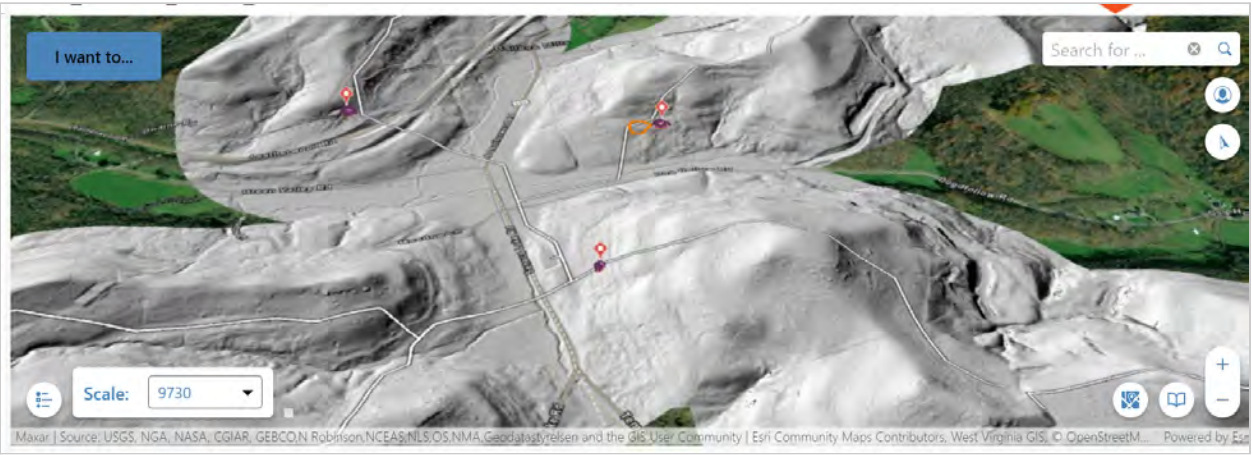


Data can additionally be filtered by clicking the filter button (highlighted in blue at top left corner of attribute table).

Clicking the three vertical dots located to the left of each row allows you to access a menu of options for exploring a record of interest. Available options include zooming to the feature, filtering the record from the selection set, and exporting the records to a file for further analysis within different applications.

Clicking the three vertical dots at the top-right of the table enables these actions for the entire table.

3-Dimensional View



The data provided through the Right-of-Way Integrity Management program shines when viewed in an oblique, 3-dimensional view. By default, all data through the Teren Viewer is enabled for 3-dimensional viewing. To access this feature, hold the right button down on your mouse (or alt-select on track pad) and move the cursor. The map will pan and rotate with your mouse.

Search

The Teren Viewer provides global search functionality, this allows for public address searches, lat/long, and features within our data tables. The search feature executes against all visible layers in the map, and against the Esri world geocoder service (global address service). This allows you to search for attributes within the data.

To search, type the value of the attribute you want to see in the Search widget on the map frame. Results will display in the attribute tables below the Viewer.

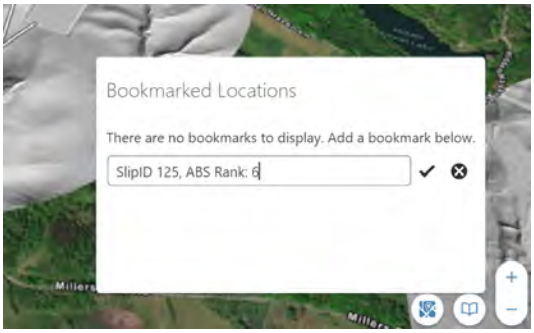
To search lat/long coordinates, the format is tuned for decimal degrees, Long,Lat. Upon executing the search, an attribute table will pop up from the bottom of the screen. Click the 3 dots to the left and hit “zoom to results”

World Geocoder for ArcGIS

Loc_name	Status	Score	Match_addr	LongLabel
World	M	100	-81.182500 40.096000	40°05'45.599"N 81°10'57.000"W

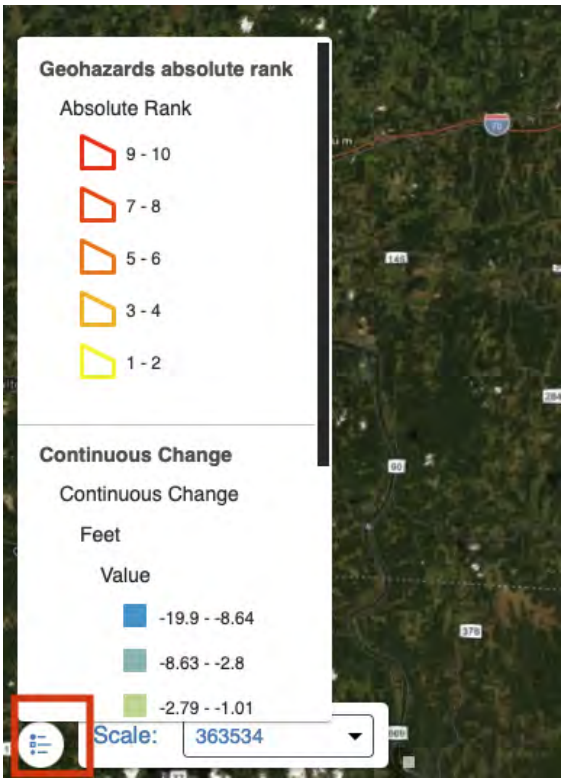
Bookmark

To save an important location and return to it at a later time, the Teren Viewer enables bookmarking of locations. To bookmark a location, select the bookmark icon in the lower right corner of the map window. Click the **Add Bookmark** button and name the bookmark. This saves the location, angle, orientation of the map at the time of the bookmarking.



Legend

To display the legend, click on the circular button in the bottom left of the data extent window. This allows the user to view the symbology of the layers turned on.



APPENDIX C Attribute table for geohazard polygons

FID	Shape *	geohazard	status	slip_id	subscripti	acquisitio	acquisit_1	system_nam	notes	longitude	latitude	client	st_area_sh	st_length	Name	volume_ft	slope_deg	aspect	geoshape	scarpdist	scarpht	scarpratio	Scarpdir	toeslpdis	toeslprank	toeslpdir	hydrology	flow_dsl	eacdist	impactang	pipeInter	abvrank	ABS_con	relthreat	relrank	Shape_Area	Shp_Length	CDF_Rel
0.0	Polygon	slip	existing	10.0	appalachia	s2023	12/30/1899	OHDOT		-80.8	39.9	Ohio DOT	41254.9	1053.7		0.0	52.6	140.0	0.1	485.6	3.5	0.1	68.0	201.0	0.1	14.0	0.8	-9999.0	342.1	7.0	0.0	1.0	hazard > 60 feet,hazard is below the pipeline,ABS_value = 1	158.8	86.3	41254.9	1053.7	86.3
1.0	Polygon	slip	existing	100.0	appalachia	s2023	12/30/1899	OHDOT		-81.3	39.8	Ohio DOT	2841.3	206.4		0.0	32.0	80.0	0.2	0.0	0.0	0.0	159.0	111.0	0.0	155.0	0.8	-9999.0	99.8	168.0	0.0	5.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 159,hazard slope = 32.04,ABS_value = 5	2.0	5.0	2841.3	206.4	5.0
2.0	Polygon	slip	existing	1018.0	appalachia	s2023	12/30/1899	OHDOT		-80.9	40.0	Ohio DOT	3432.7	224.4		0.0	53.8	358.0	0.2	0.0	0.0	0.0	15.0	88.0	0.0	2.0	0.9	-9999.0	105.0	16.0	0.0	3.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 15,hazard slope = 53.77,ABS_value = 3	4.1	9.4	3432.7	224.4	9.4
3.0	Polygon	slip	existing	103.0	appalachia	s2023	12/30/1899	OHDOT		-81.3	39.8	Ohio DOT	4703.4	321.8		0.0	23.0	160.0	0.2	0.0	0.0	0.0	142.0	182.0	0.0	143.0	0.6	-9999.0	176.3	145.0	0.0	4.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 142,hazard slope = 22.95,ABS_value = 4	1.4	2.5	4703.4	321.8	2.5
4.0	Polygon	slip	existing	108.0	appalachia	s2023	12/30/1899	OHDOT		-81.3	40.1	Ohio DOT	6165.1	327.2		0.0	49.6	159.0	0.2	0.0	0.0	0.0	2.0	128.0	0.0	1.0	0.9	-9999.0	149.9	6.0	0.0	3.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 2,hazard slope = 49.64,ABS_value = 3	5.3	16.3	6165.1	327.2	16.3
5.0	Polygon	slip	existing	11.0	appalachia	s2023	12/30/1899	OHDOT		-81.3	39.9	Ohio DOT	17374.4	588.6	SNOBSR00147**C	0.0	21.9	271.0	0.1	0.0	0.0	0.0	10.0	121.0	0.0	27.0	0.7	-9999.0	144.4	20.0	0.0	2.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 10,hazard slope = 21.92,ABS_value = 2	6.1	19.4	17374.4	588.6	19.4
6.0	Polygon	slip	existing	119.0	appalachia	s2023	12/30/1899	OHDOT		-81.2	40.0	Ohio DOT	2714.0	200.1		0.0	34.3	230.0	0.2	43.0	2.1	0.1	14.0	11.0	0.1	1.0	0.9	-9999.0	25.2	8.0	0.0	5.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 14,hazard slope = 34.34,ABS_value = 5	57.9	76.3	2714.0	200.1	76.3
7.0	Polygon	slip	existing	12.0	appalachia	s2023	12/30/1899	OHDOT		-81.3	39.8	Ohio DOT	112972.2	407.6	SMOESR00078**C	0.0	41.9	1.0	0.1	0.0	0.0	0.0	2.0	70.0	0.0	1.0	0.8	-9999.0	116.8	1.0	0.0	3.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 2,hazard slope = 41.88,ABS_value = 3	19.4	54.4	112972.2	407.6	54.4
8.0	Polygon	slip	existing	13.0	appalachia	s2023	12/30/1899	OHDOT		-81.1	39.8	Ohio DOT	12196.5	438.5		0.0	25.6	116.0	0.1	0.0	0.0	0.0	149.0	273.0	0.0	148.0	0.9	-9999.0	241.0	149.0	0.0	1.0	hazard > 60 feet,hazard is below the pipeline,ABS_value = 1	2.9	6.3	12196.5	438.5	6.3
9.0	Polygon	slip	existing	1336.0	appalachia	s2023	12/30/1899	OHDOT		-80.9	40.0	Ohio DOT	12582.0	421.7		0.0	27.8	117.0	0.1	0.0	0.0	0.0	142.0	208.0	0.0	153.0	0.9	-9999.0	168.5	153.0	0.0	4.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 142,hazard slope = 27.78,ABS_value = 4	4.6	15.0	12582.0	421.7	15.0
10.0	Polygon	slip	existing	1390.0	appalachia	s2023	12/30/1899	OHDOT		-81.3	39.8	Ohio DOT	13522.5	443.4		0.0	23.9	244.0	0.1	240.4	1.5	0.1	33.0	162.0	0.2	20.0	0.9	-9999.0	203.6	23.0	0.0	1.0	hazard > 60 feet,hazard is below the pipeline,ABS_value = 1	17.3	50.0	13522.5	443.4	50.0
11.0	Polygon	slip	existing	14.0	appalachia	s2023	12/30/1899	OHDOT		-81.0	39.8	Ohio DOT	7670.6	472.2	SMOESR00078**C	0.0	43.0	181.0	0.2	0.0	0.0	0.0	170.0	63.0	0.0	179.0	0.7	-9999.0	47.0	170.0	0.0	5.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 170,hazard slope = 43.04,ABS_value = 5	15.4	45.0	7670.6	472.2	45.0
12.0	Polygon	slip	existing	1491.0	appalachia	s2023	12/30/1899	OHDOT		-81.3	39.8	Ohio DOT	28773.9	692.1		0.0	24.4	314.0	0.1	0.0	0.0	0.0	99.0	296.0	0.0	101.0	0.8	-9999.0	225.9	96.0	0.0	1.0	hazard > 60 feet,hazard is below the pipeline,ABS_value = 1	6.9	21.3	28773.9	692.1	21.3
13.0	Polygon	slip	existing	15.0	appalachia	s2023	12/30/1899	OHDOT		-81.0	39.8	Ohio DOT	6091.5	286.6	SMOESR00078**C	1538.9	41.7	327.0	0.1	0.0	0.0	0.0	80.0	81.0	0.0	78.0	0.9	-9999.0	53.3	71.0	0.0	3.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 80,hazard slope = 41.66,ABS_value = 3	10.5	33.1	6091.5	286.6	33.1
14.0	Polygon	slip	existing	16.0	appalachia	s2023	12/30/1899	OHDOT		-81.1	39.8	Ohio DOT	22151.8	900.1		10817.4	46.2	176.0	0.1	0.0	0.0	0.0	170.0	64.0	0.0	176.0	0.5	-9999.0	54.1	169.0	0.0	5.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 170,hazard slope = 46.17,ABS_value = 5	41.5	71.3	22151.8	900.1	71.3
15.0	Polygon	slip	existing	161.0	appalachia	s2023	12/30/1899	OHDOT		-81.3	39.8	Ohio DOT	30678.0	740.6		0.0	22.4	207.0	0.1	0.0	0.0	0.0	166.0	279.0	0.0	126.0	0.8	-9999.0	242.3	139.0	0.0	1.0	hazard > 60 feet,hazard is below the pipeline,ABS_value = 1	6.2	20.0	30678.0	740.6	20.0
16.0	Polygon	slip	existing	1666.0	appalachia	s2023	12/30/1899	OHDOT		-81.3	40.1	Ohio DOT	5492.2	281.0		0.0	28.5	228.0	0.2	0.0	0.0	0.0	122.0	197.0	0.0	132.0	0.8	-9999.0	172.9	122.0	0.0	2.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 122,hazard slope = 28.47,ABS_value = 2	2.0	4.4	5492.2	281.0	4.4
17.0	Polygon	slip	existing	167.0	appalachia	s2023	12/30/1899	OHDOT		-81.3	39.8	Ohio DOT	6405.0	317.0		242.3	26.3	336.0	0.2	0.0	0.0	0.0	17.0	20.0	0.0	20.0	0.9	-9999.0	38.8	18.0	0.0	2.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 17,hazard slope = 26.32,ABS_value = 2	10.1	32.5	6405.0	317.0	32.5
18.0	Polygon	slip	existing	17.0	appalachia	s2023	12/30/1899	OHDOT		-80.8	39.9	Ohio DOT	254197.2	2467.5		0.0	48.1	129.0	0.0	0.0	0.0	0.0	63.0	136.0	0.1	25.0	0.8	-9999.0	268.0	1.0	0.0	1.0	hazard > 60 feet,hazard is below the pipeline,ABS_value = 1	218.3	89.4	254197.2	2467.5	89.4
19.0	Polygon	slip	existing	1754.0	appalachia	s2023	12/30/1899	OHDOT		-80.9	39.7	Ohio DOT	13945.9	449.0		0.0	62.7	167.0	0.1	0.0	0.0	0.0	97.0	177.0	0.0	77.0	0.9	-9999.0	212.7	90.0	0.0	1.0	hazard > 60 feet,hazard is below the pipeline,ABS_value = 1	9.1	28.8	13945.9	449.0	28.8
20.0	Polygon	slip	existing	1843.0	appalachia	s2023	12/30/1899	OHDOT		-81.0	40.0	Ohio DOT	4575.5	266.0		0.0	23.8	41.0	0.2	0.0	0.0	0.0	153.0	86.0	0.0	153.0	0.9	-9999.0	54.4	156.0	0.0	4.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 153,hazard slope = 23.76,ABS_value = 4	4.4	13.8	4575.5	266.0	13.8
21.0	Polygon	slip	existing	19.0	appalachia	s2023	12/30/1899	OHDOT		-80.9	39.6	Ohio DOT	89958.0	1224.0		0.0	51.4	352.0	0.0	54.9	4.7	0.0	172.0	221.0	0.0	114.0	0.8	-9999.0	124.5	46.0	0.0	3.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 172,hazard slope = 51.43,ABS_value = 3	1057.8	95.0	89958.0	1224.0	95.0
22.0	Polygon	slip	existing	198.0	appalachia	s2023	12/30/1899	OHDOT		-81.3	39.8	Ohio DOT	43844.9	782.2	SNOBSR00513**C	0.0	32.5	96.0	0.1	0.0	0.0	0.0	174.0	211.0	0.0	174.0	0.9	-9999.0	132.9	175.0	0.0	5.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 175,hazard slope = 32.53,ABS_value = 5	23.6	60.6	43844.9	782.2	60.6
23.0	Polygon	slip	existing	20.0	appalachia	s2023	12/30/1899	OHDOT		-81.3	39.9	Ohio DOT	17293.3	585.6		0.0	23.8	173.0	0.1	0.0	0.0	0.0	172.0	234.0	0.0	173.0	0.9	-9999.0	200.5	173.0	0.0	1.0	hazard > 60 feet,hazard is below the pipeline,ABS_value = 1	4.5	14.4	17293.3	585.6	14.4
24.0	Polygon	slip	existing	203.0	appalachia	s2023	12/30/1899	OHDOT		-81.3	39.8	Ohio DOT	42871.8	897.4		0.0	28.2	189.0	0.1	0.0	0.0	0.0	51.0	268.0	0.0	17.0	0.8	-9999.0	194.8	45.0	0.0	2.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 51,hazard slope = 28.21,ABS_value = 2	13.9	41.9	42871.8	897.4	41.9
25.0	Polygon	slip	existing	21.0	appalachia	s2023	12/30/1899	OHDOT		-81.3	40.1	Ohio DOT	13731.8	747.0	SGUEIR00070**N	0.0	46.8	182.0	0.2	0.0	0.0	0.0	92.0	93.0	0.0	92.0	0.8	-9999.0	107.5	92.0	0.0	3.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 92,hazard slope = 46.81,ABS_value = 3	13.2	40.0	13731.8	747.0	40.0
26.0	Polygon	slip	existing	22.0	appalachia	s2023	12/30/1899	OHDOT		-80.9	40.0	Ohio DOT	25055.7	605.2		0.0	38.1	173.0	0.1	280.3	3.0	0.2	106.0	139.0	0.2	97.0	0.9	-9999.0	214.0	97.0	0.0	1.0	hazard > 60 feet,hazard is below the pipeline,ABS_value = 1	83.9	80.0	25055.7	605.2	80.0
27.0	Polygon	slip	existing	23.0	appalachia	s2023	12/30/1899	OHDOT		-81.0	40.0	Ohio DOT	15677.3	507.4	SBELSR00009**C	0.0	43.3	280.0	0.1	182.2	3.1	0.1	12.0	47.0	0.2	20.0	0.9	-9999.0	108.0	18.0	0.0	5.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 12,hazard slope = 43.29,ABS_value = 5	128.4	83.1	15677.3	507.4	83.1
28.0	Polygon	slip	existing	24.0	appalachia	s2023	12/30/1899	OHDOT		-81.0	40.0	Ohio DOT	179133.0	1595.4	SBELSR00009**C	1881.7	31.6	272.0	0.0	74.1	2.5	0.0	74.0	300.0	0.0	178.0	0.9	-9999.0	161.6	178.0	0.0	5.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 74,hazard slope = 31.63,ABS_value = 5	552.3	93.8	179133.0	1595.4	93.8
29.0	Polygon	slip	existing	25.0	appalachia	s2023	12/30/1899	OHDOT		-81.3	39.9	Ohio DOT	26424.5	641.2		0.0	22.4	133.0	0.1	288.6	1.4	0.1	14.0	182.0	0.1	17.0	0.8	-9999.0	234.4	13.0	0.0	1.0	hazard > 60 feet,hazard is below the pipeline,ABS_value = 1	26.8	63.8	26424.5	641.2	63.8
30.0	Polygon	slip	existing	27.0	appalachia	s2023	12/30/1899	OHDOT		-81.3	39.8	Ohio DOT	52246.4	327.7	SMOESR00078**C	0.0	58.7	195.0	0.2	0.0	0.0	0.0	172.0	48.0	0.0	165.0	0.8	-9999.0	34.4	166.0	0.0	5.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 172,hazard slope = 58.69,ABS_value = 5	19.6	55.0	52246.4	327.7	55.0
31.0	Polygon	slip	existing	29.0	appalachia	s2023	12/30/1899	OHDOT		-81.3	39.8	Ohio DOT	31722.7	745.4		0.0	28.7	275.0	0.1	0.0	0.0	0.0	175.0	151.0	0.0	175.0	0.9	-9999.0	91.9	175.0	0.0	4.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 175,hazard slope = 28.68,ABS_value = 4	21.8	58.1	31722.7	745.4	58.1
32.0	Polygon	slip	existing	30.0	appalachia	s2023	12/30/1899	OHDOT		-80.9	39.6	Ohio DOT	134761.9	1566.3	SMOESR00255**C	0.0	41.4	224.0	0.0	0.0	0.0	0.0	29.0	97.0	0.0	46.0	0.7	-9999.0	173.5	30.0	0.0	3.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 29,hazard slope = 41.37,ABS_value = 3	72.8	78.8	134761.9	1566.3	78.8
33.0	Polygon	slip	existing	31.0	appalachia	s2023	12/30/1899	OHDOT		-80.9	39.6	Ohio DOT	11776.7	462.4	SMOESR00255**C	0.0	60.0	262.0	0.1	0.0	0.0	0.0	163.0	181.0	0.0	198.0	0.9	-9999.0	117.0	182.0	0.0	5.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 163,hazard slope = 59.99,ABS_value = 5	13.2	40.6	11776.7	462.4	40.6
34.0	Polygon	slip	existing	33.0	appalachia	s2023	12/30/1899	OHDOT		-80.8	40.2	Ohio DOT	126725.1	1692.7		0.0	36.9	125.0	0.0	0.0	0.0	0.0	7.0	225.0	0.0	0.0	0.6	-9999.0	318.1	1.0	0.0	1.0	hazard > 60 feet,hazard is below the pipeline,ABS_value = 1	70.5	78.1	126725.1	1692.7	78.1
35.0	Polygon	slip	existing	34.0	appalachia	s2023	12/30/1899	OHDOT		-81.3	39.8	Ohio DOT	117043.6	1628.0	SNOBSR00513**C	78.3	26.3	90.0	0.0	0.0	0.0	0.0	176.0	256.0	0.0	180.0	0.9	-9999.0	190.8	180.0	0.0	4.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 176,hazard slope = 26.34,ABS_value = 4	35.5	67.5	117043.6	1628.0	67.5
36.0	Polygon	slip	existing	37.0	appalachia	s2023	12/30/1899	OHDOT		-80.8	40.1	Ohio DOT	10293.5	516.1	SBELLSS00250**C	0.0	41.0	27.0	0.2	0.0	0.0	0.0	157.0	80.0	0.0	218.0	0.7	-9999.0	46.0	222.0	0.0	5.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 157,hazard slope = 40.98,ABS_value = 5	20.1	55.6	10293.5	516.1	55.6
37.0	Polygon	slip	existing	40.0	appalachia	s2023	12/30/1899	OHDOT		-81.3	39.8	Ohio DOT	61329.5	950.1	SMOESR00078**C	0.0	33.0	203.0	0.2	29.7	2.6	0.1	22.0	44.0	0.1	6.0	0.9	-9999.0	137.8	6.0	0.0	5.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 22,hazard slope = 32.95,ABS_value = 5	296.8	90.6	61329.5	950.1	90.6
38.0	Polygon	slip	existing	41.0	appalachia	s2023	12/30/1899	OHDOT		-81.3	39.8	Ohio DOT	132958.8	2766.4	SMOESR00078**C	0.0	33.0	140.0	0.1	137.5	2.4	0.0	7.0	40.0	0.1	7.0	0.3	-9999.0	89.0	11.0	0.0	5.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 7,hazard slope = 32.97,ABS_value = 5	818.5	94.4	132958.8	2766.4	94.4
39.0	Polygon	slip	existing	42.0	appalachia	s2023	12/30/1899	OHDOT		-81.4	40.0	Ohio DOT	59850.0	2030.6	SGUEIR00070**N	0.0	39.1	176.0	0.1	0.0	0.0	0.0	176.0	80.0	0.0	176.0	0.7	-9999.0	53.8	173.0	0.0	5.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 176,hazard slope = 39.13,ABS_value = 5	95.4	80.6	59850.0	2030.6	80.6
40.0	Polygon	slip	existing	43.0	appalachia	s2023	12/30/1899	OHDOT		-81.4	40.0	Ohio DOT	52325.2	1143.6	SGUEIR00070**C	89.6	40.6	5.0	0.1	0.0	0.0	0.0	6.0	112.0	0.0	5.0	0.7	-9999.0	157.2	6.0	0.0	3.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 6,hazard slope = 40.58,ABS_value = 3	35.3	66.9	52325.2	1143.6	66.9
41.0	Polygon	slip	existing	4558.0	appalachia	s2023	12/30/1899	OHDOT		-80.8	40.2	Ohio DOT	2761.4	204.5		73.3	40.5	157.0	0.2	0.0	0.0	0.0	5.0	142.0	0.0	1.0	0.9	-9999.0	166.1	1.0	0.0	3.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 5,hazard slope = 40.49,ABS_value = 3	3.2	6.9	2761.4	204.5	6.9
42.0	Polygon	slip	existing	4563.0	appalachia	s2023	12/30/1899	OHDOT		-81.1	40.1	Ohio DOT	20794.5	622.2		0.0	26.5	300.0	0.1	0.0	0.0	0.0	117.0	322.0	0.0	105.0	0.8	-9999.0	231.1	102.0	0.0	1.0	hazard > 60 feet,hazard is below the pipeline,ABS_value = 1	5.3	15.6	20794.5	622.2	15.6
43.0	Polygon	slip	existing	4631.0	appalachia	s2023	12/30/1899	OHDOT		-81.2	40.0	Ohio DOT	21519.0	688.3		0.0	32.6	135.0	0.1	0.0	0.0	0.0	72.0	77.0	0.0	72.0	0.6	-9999.0	125.8	14.0	0.0	3.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 72,hazard slope = 32.57,ABS_value = 3	13.2	39.4	21519.0	688.3	39.4
44.0	Polygon	slip	existing	500.0	appalachia	s2023	12/30/1899	OHDOT		-81.0	40.3	Ohio DOT	7591.7	410.1	SHASSR00009**C	0.0	44.8	281.0	0.2	159.1	2.8	0.1	0.0	32.0	0.2	11.0	0.9	-9999.0	91.5	0.0	0.0	5.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 0,hazard slope = 44.8,ABS_value = 5	0.0	1.3	7591.7	410.1	1.3
45.0	Polygon	slip	existing	504.0	appalachia	s2023	12/30/1899	OHDOT		-81.0	40.3	Ohio DOT	13115.5	497.9	SMOESR00078**C	0.0	33.2	36.0	0.1	0.0	0.0	0.0	146.0	157.0	0.0	126.0	0.6	-9999.0	117.3	170.0	0.0	5.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 146,hazard slope = 33.19,ABS_value = 5	8.2	27.5	13115.5	497.9	27.5
46.0	Polygon	slip	existing	506.0	appalachia	s2023	12/30/1899	OHDOT		-81.0	39.8	Ohio DOT	9768.5	457.1	SMOESR00078**C	0.0	47.3	167.0	0.1	80.9	3.1	0.1	100.0	38.0	0.1	103.0	0.8	-9999.0	57.2	101.0	0.0	5.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 100,hazard slope = 47.33,ABS_value = 5	157.1	85.6	9768.5	457.1	85.6
47.0	Polygon	resolved	existing	507.0	appalachia	s2023	12/30/1899	OHDOT		-81.0	39.8	Ohio DOT	281.8	68.3	SMOESR00078**C	0.0	23.9	306.0	0.8	21.6	1.0	0.1	131.0	26.0	0.2	117.0	0.7	-9999.0	21.8	141.0	0.0	1.0	hazard <= 60 feet,hazard is 100% below pipeline,hazard area =281.85,scarp slope angle = 131,hazard slope = 23.88,ABS_value = 1	2.4	5.6	281.8	68.3	5.6
48.0	Polygon	slip	existing	508.0	appalachia	s2023	12/30/1899	OHDOT		-81.3	39.8	Ohio DOT	3549.1	231.6	SNOBSR00513**C	0.0	42.2	96.0	0.2	0.0	0.0	0.0	11.0	51.0	0.0	17.0	0.8	-9999.0	84.2	12.0	0.0	3.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 11,hazard slope = 42.17,ABS_value = 3	4.3	10.6	3549.1	231.6	10.6
49.0	Polygon	resolved	existing	509.0	appalachia	s2023	12/30/1899	OHDOT		-80.8	39.9	Ohio DOT	613.5	95.9	SBELSR00007**C	0.0	55.8	162.0	0.5	35.3	6.3	0.2	116.0	20.0	0.0	108.0	0.8	-9999.0	27.7	109.0	0.0	4.0	hazard <= 60 feet,hazard is 100% below pipeline,hazard area =613.47,scarp slope angle = 116,hazard slope = 55.75,ABS_value = 4	45.5	73.1	613.5	95.9	73.1
50.0	Polygon	slip	existing	510.0	appalachia	s2023	12/30/1899	OHDOT		-81.0	40.0	Ohio DOT	36361.9	790.5		0.0	34.4	308.0	0.1	0.0	0.0	0.0	124.0	467.0	0.0	129.0	0.8	-9999.0	387.8	136.0	0.0	1.0	hazard > 60 feet,hazard is below the pipeline,ABS_value = 1	7.1	21.9	36361.9	790.5	21.9
51.0	Polygon	slip	existing	511.0	appalachia	s2023	12/30/1899	OHDOT		-81.0	40.3	Ohio DOT	2723.3	206.4	SHASSR00151**C	0.0	67.4	217.0	0.2	9.6	3.6	0.2	144.0	8.0	0.0	217.0	0.9	37.3	9.8	144.0	1.0	9.0	hazard <= 60 feet,hazard intersect ratio = 0.97,scarp slope angle = 144 and toe slope angle = 217,hazard slope = 67.35,scarp height = 3.63,circle ratio = 0.238,scarp intersect ratio = 0.22,hazard area =2723.27,ABS_value = 9	60830.9	98.8	2723.3	206.4	98.8
52.0	Polygon	slip	existing	512.0	appalachia	s2023	12/30/1899	OHDOT		-81.0	39.6	Ohio DOT	16470.8	605.7		0.0	24.2	299.0	0.1	0.0	0.0	0.0	117.0	200.0	0.0	61.0	0.8	-9999.0	481.0	135.0	0.0	1.0	hazard > 60 feet,hazard is below the pipeline,ABS_value = 1	1.8	3.1	16470.8	605.7	3.1
53.0	Polygon	slip	existing	513.0	appalachia	s2023	12/30/1899	OHDOT		-81.3	40.0	Ohio DOT	16453.1	544.5		0.0	33.1	147.0	0.1	90.3	2.3	0.1	10.0	23.0	0.1	2.0	0.7	-9999.0	57.4	4.0	0.0	5.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 10,hazard slope = 33.12,ABS_value = 5	178.9	88.1	16453.1	544.5	88.1
54.0	Polygon	slip	existing	514.0	appalachia	s2023	12/30/1899	OHDOT		-81.3	40.0	Ohio DOT	8975.6	363.0	SGUESR00265**C	0.0	20.4	202.0	0.1	142.1	1.4	0.1	81.0	83.0	0.1	85.0	0.9	-9999.0	116.7	89.0	0.0	4.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 81,hazard slope = 20.44,ABS_value = 4	16.0	46.9	8975.6	363.0	46.9
55.0	Polygon	slip	existing	515.0	appalachia	s2023	12/30/1899	OHDOT		-81.3	40.0	Ohio DOT	5434.4	281.1		0.0	34.2	143.0	0.2	87.6	2.1	0.0	1.0	30.0	0.2	16.0	0.9	-9999.0	54.3	8.0	0.0	5.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 1,hazard slope = 34.16,ABS_value = 5	54.0	75.6	5434.4	281.1	75.6
56.0	Polygon	slip	existing	517.0	appalachia	s2023	12/30/1899	OHDOT		-81.3	40.0	Ohio DOT	6788.1	378.3	SGUESR00513**C	0.0	42.3	248.0	0.2	0.0	0.0	0.0	176.0	58.0	0.0	183.0	0.8	-9999.0	36.2	176.0	0.0	5.0	hazard <= 60 feet,hazard is 100% below pipeline,scarp slope angle = 176,hazard slope = 42.27,ABS_value = 5	17.4	50.6	6788.1	378.3	50.6
57.0

APPENDIX C

Attribute table for geohazard polygons

| | | |

APPENDIX C Attribute table for change detection polygons

FID	Shape *	AREA	MIN	MAX	SUM	id	volume_ft
0	Polygon	162.24	1	2.45	143.36	1	242.2784
1	Polygon	76.05	1	1.91	62.61	2	105.8109
2	Polygon	3876.860001	1	4.26	4520.37	3	7639.4253
3	Polygon	62.53	1	1.53	43.38	4	73.3122
4	Polygon	160.55	1	1.45	111.91	5	189.1279
5	Polygon	997.1	1	6.85	1113.45	6	1881.7305
6	Polygon	47.32	1.04	2.81	49.56	7	83.7564
7	Polygon	1012.31	1.01	7.02	1591.34	8	2689.3646
8	Polygon	469.82	1	4.4	497.81	9	841.2989
9	Polygon	250.12	1.01	3.38	280.58	10	474.1802
10	Polygon	113.23	1.01	3.05	109.93	11	185.7817
11	Polygon	32.11	1.01	2.08	27.29	12	46.1201
12	Polygon	40.56	1.02	3.2	46.33	13	78.2977
13	Polygon	33.8	1.01	1.54	24.05	14	40.6445
14	Polygon	59.15	1.02	1.92	49.3	15	83.317
15	Polygon	33.8	1.01	1.36	23.4	16	39.546
16	Polygon	101.4	1	1.36	65.21	17	110.2049
17	Polygon	89.57	1	1.92	70.41	18	118.9929
18	Polygon	37.18	1.01	1.58	28.45	19	48.0805
19	Polygon	49.01	1.06	1.6	36.41	20	61.5329
20	Polygon	104.78	1	1.97	87.25	21	147.4525
21	Polygon	109.85	1.01	2.19	95.09	22	160.7021
22	Polygon	67.6	1.06	1.69	52.36	23	88.4884
23	Polygon	968.37	1	5.37	1107.94	24	1872.4186
24	Polygon	735.15	1	3.31	673.98	25	1139.0262
25	Polygon	160.55	1.02	3.54	178.44	26	301.5636
26	Polygon	30.42	1.01	1.53	22.15	27	37.4335
27	Polygon	82.81	1	2.14	64.56	28	109.1064
28	Polygon	94.64	1.01	8.02	216.23	29	365.4287
29	Polygon	101.4	1	3.07	110.4	30	186.576
30	Polygon	775.71	1	5.69	1041.42	31	1759.9998
31	Polygon	38.87	1.01	2.98	46.09	32	77.8921
32	Polygon	179.14	1	2.78	150.47	33	254.2943
33	Polygon	57.46	1	1.49	41.71	34	70.4899
34	Polygon	50.7	1	2.03	39.72	35	67.1268
35	Polygon	89.57	1	1.67	66.7	36	112.723
36	Polygon	1228.63	1	2.3	1130.3	37	1910.207
37	Polygon	32.11	1.03	1.95	26.66	38	45.0554
38	Polygon	64.22	1.04	3.95	76.91	39	129.9779
39	Polygon	114.92	1	3.33	116.08	40	196.1752
40	Polygon	187.59	1.01	2.99	221.21	41	373.8449
41	Polygon	165.62	1	1.73	127.65	42	215.7285
42	Polygon	43.94	1.01	1.8	32.22	43	54.4518
43	Polygon	434.33	1.97	7.32	1130.65	44	1910.7985
44	Polygon	878.8	1.89	9.28	2587.08	45	4372.1652
45	Polygon	62.53	3.24	5.87	161.49	46	272.9181
46	Polygon	1664.65	1	8.47	3107.25	47	5251.2525
47	Polygon	488.41	1	6.35	910.61	48	1538.9309
48	Polygon	5696.990001	1	6.8	6400.81	49	10817.3689
49	Polygon	33.8	1	3.12	33.64	50	56.8516
50	Polygon	54.08	1	3.13	53.01	51	89.5869
51	Polygon	2330.51	1	3.31	2166.06	52	3660.6414
52	Polygon	750.36	1	2.81	731.3	53	1235.897
53	Polygon	33.8	1.13	1.65	26.44	54	44.6836
54	Polygon	184.21	1.02	5.76	261.16	55	441.3604
55	Polygon	116.61	1.02	2.6	105.12	56	177.6528
56	Polygon	118.3	1.25	2.42	118.84	57	200.8396
57	Polygon	143.65	1.04	1.73	108.03	58	182.5707
58	Polygon	199.42	1.01	2.58	184.65	59	312.0585
59	Polygon	381.94	1.01	3.53	372.98	60	630.3362
60	Polygon	219.7	1.01	2.65	206.56	61	349.0864
61	Polygon	6477.770001	1	5.81	9729.66	62	16443.1254
62	Polygon	3743.350001	1	7.44	5850.42	63	9887.2098
63	Polygon	2291.64	1	2.31	2070.35	64	3498.8915

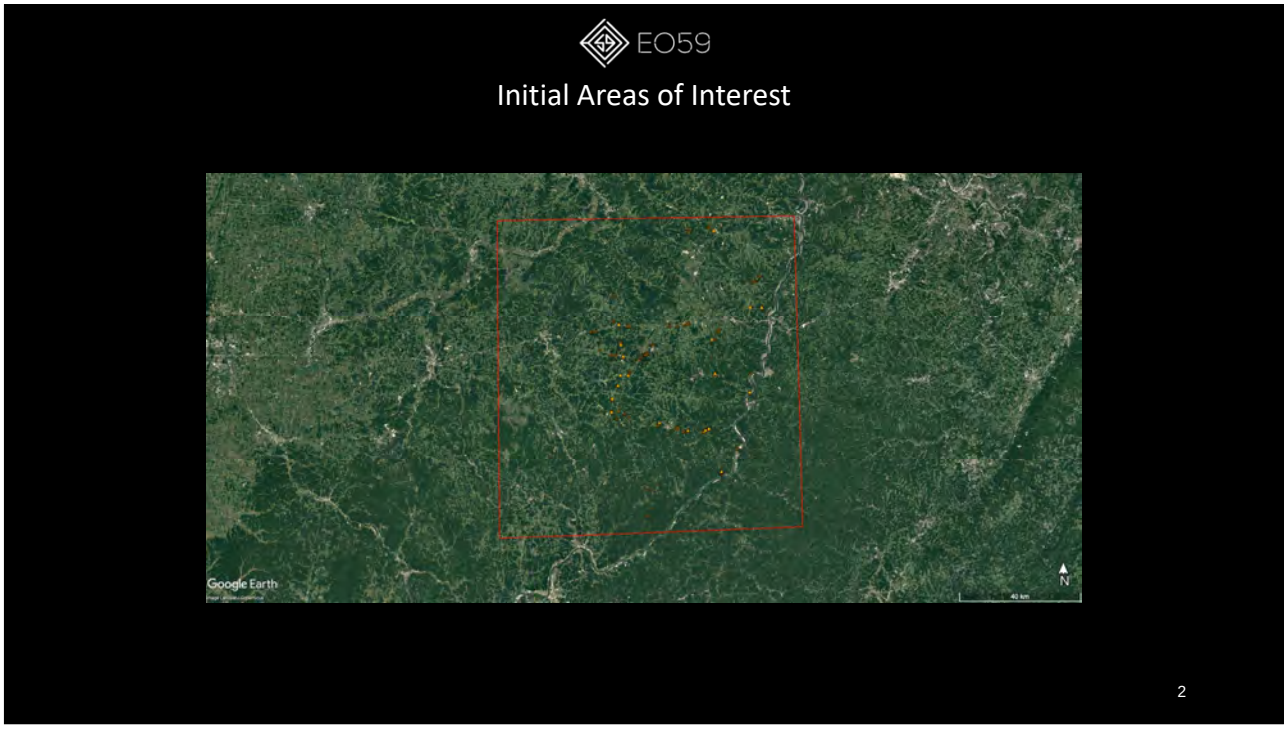
APPENDIX D:

RESOURCES FROM EO59 (INSAR)

- Hand-off presentation: ODOT Landslides
- Summary table of InSAR data coverage by study region.
- Tables of average velocity and cumulative displacement for each PS point in study region for time period specified by EO59 (SP2016 to SP2023) and for study period (AU2020-SP2023).

EO59
ODOT Landslides
Research Project

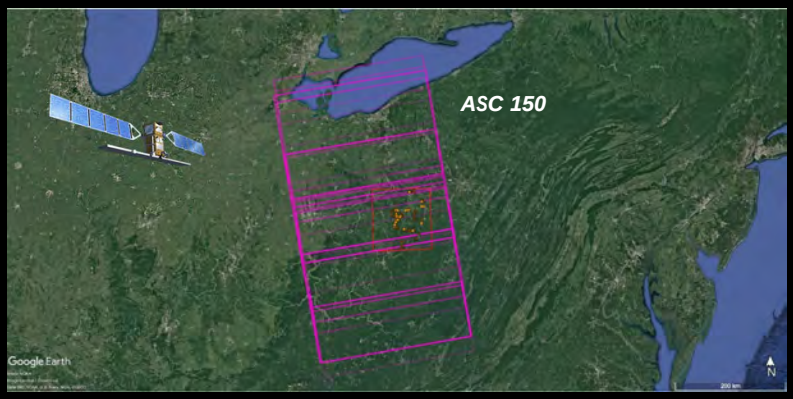
1


EO59
Initial Areas of Interest
Google Earth
N
2

2

EO59

Sentinel -1 data



Footprint of the Sentinel-1 data (Ascending orbit) covering the area of interest.

Sentinel-1 European Space Agency (ESA)

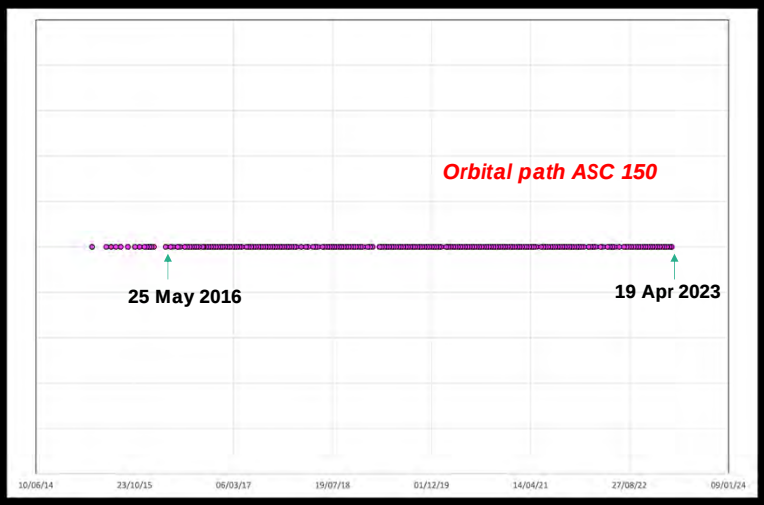
Ground Resolution: 20x5 m
Revisited Times: 12 days

3

3

EO59

Sentinel-1 Time Distribution



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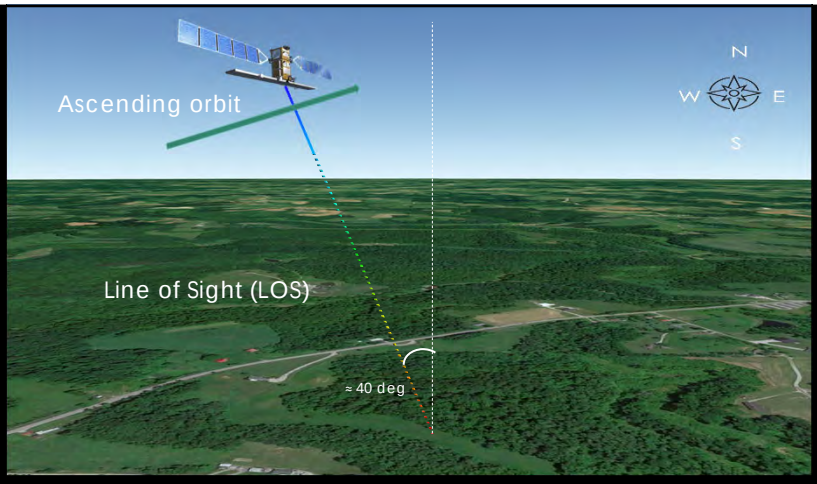
4



Geometry of acquisition from Ascending orbit.

The colored arrow represents the vertical projection of the Line Of Sight (LOS).
The incidence angle is ≈ 40, ascending orbit, degrees with respect to the normal to the ground.

EO59

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EO59

Area of interest Jefferson SR150

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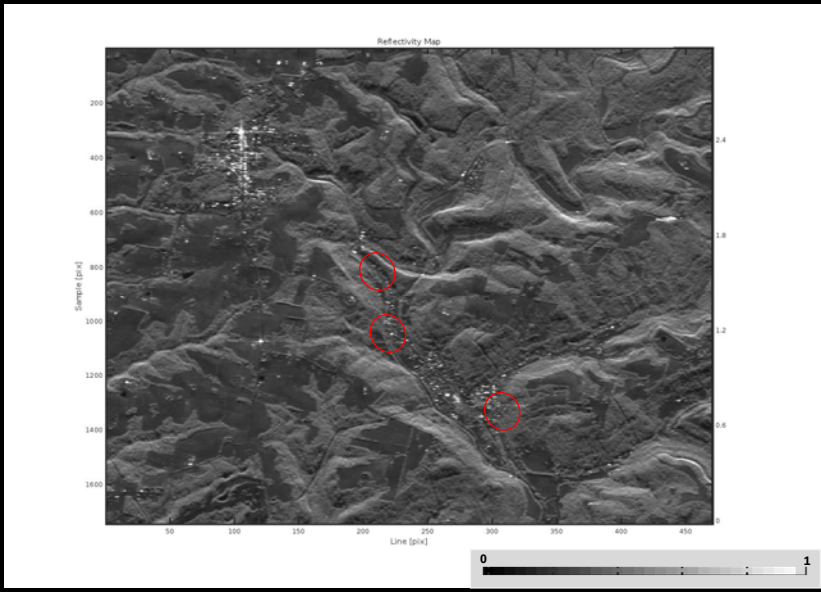
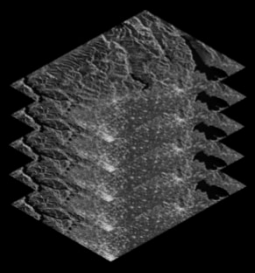
EO59

Reflectivity Map – AOI Jefferson SR150



This is the amplitude mean values of radar images, representing the mean reflectivity of pixels over time.



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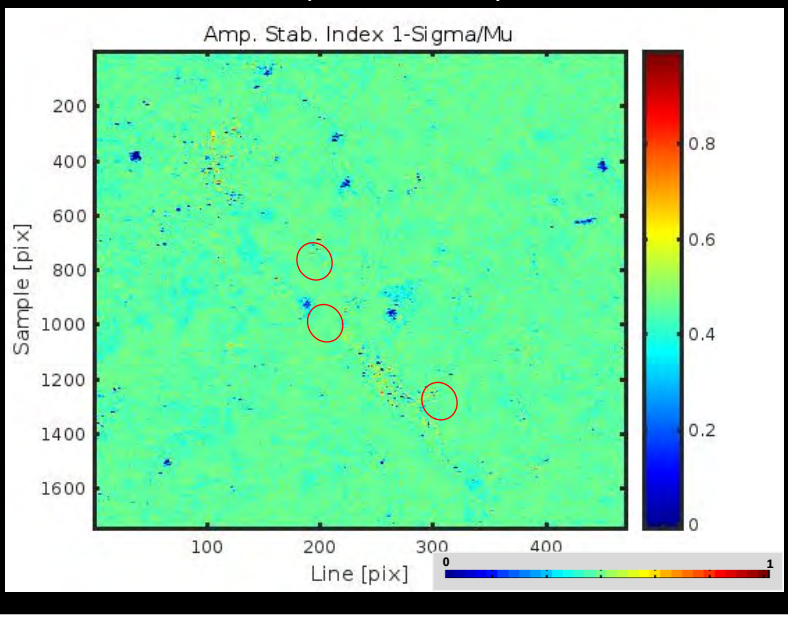
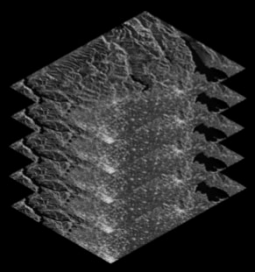
EO59

Amplitude stability index - AOI Jefferson SR150



In the image on the left we have a representation of the stability of the reflectivity over time.



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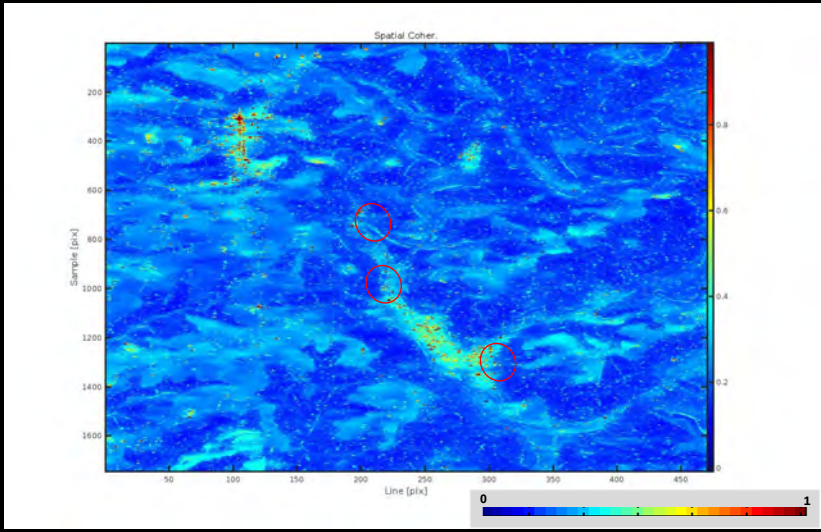
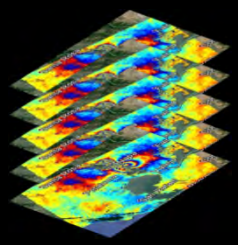
EO59

Interferometric coherence - AOI Jefferson SR150



Average interferometric coherence of the interferograms.



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EO59

Area of interest Monroe (East) SR78

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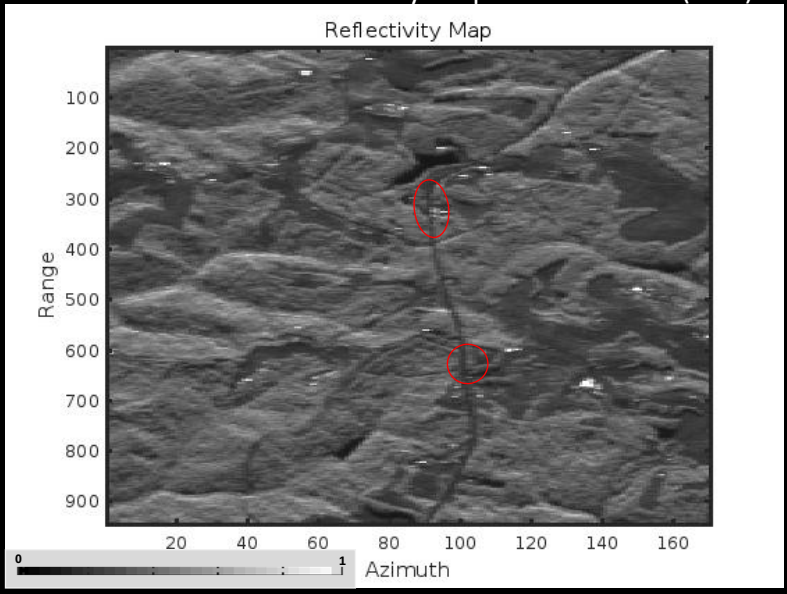
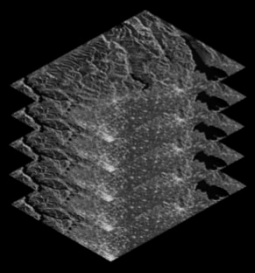
EO59

Reflectivity Map - AOI Monroe (East) SR78



This is the amplitude mean values of radar images, representing the mean reflectivity of pixels over time.



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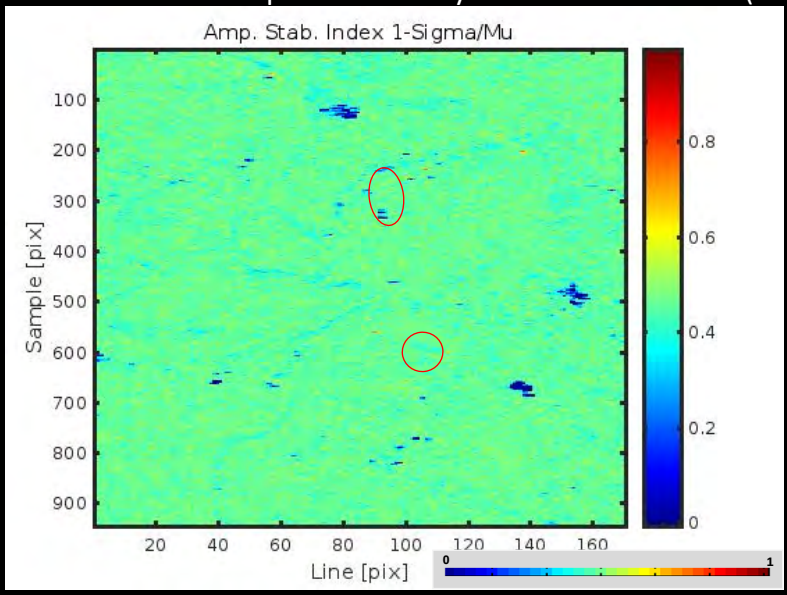
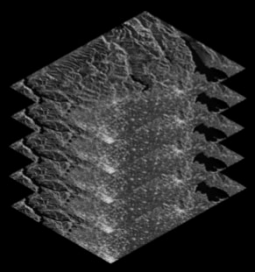
EO59

Amplitude stability index - AOI M onroe (East) SR78



In the image on the left we have a representation of the stability of the reflectivity over time.



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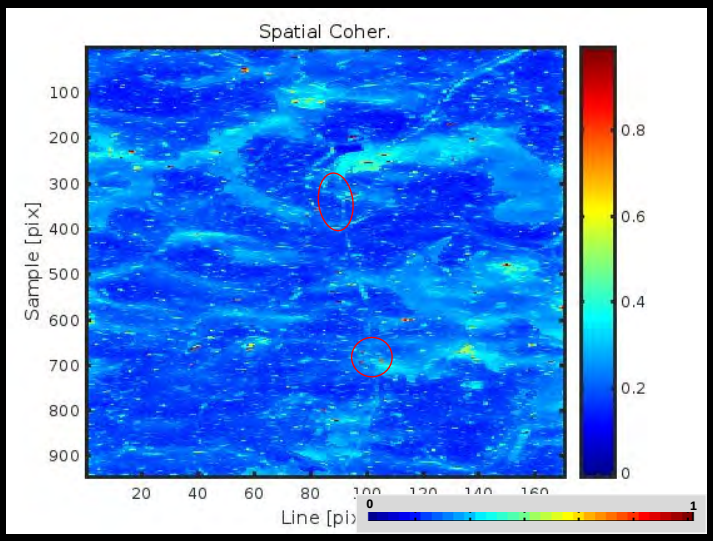
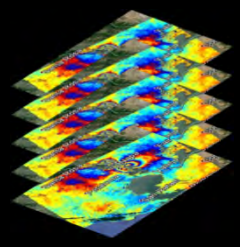
EO59

Interferometric coherence - AOI M onroe (East) SR78



Average interferometric coherence of the interferograms.



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EO59

Area of interest M onroe SR7

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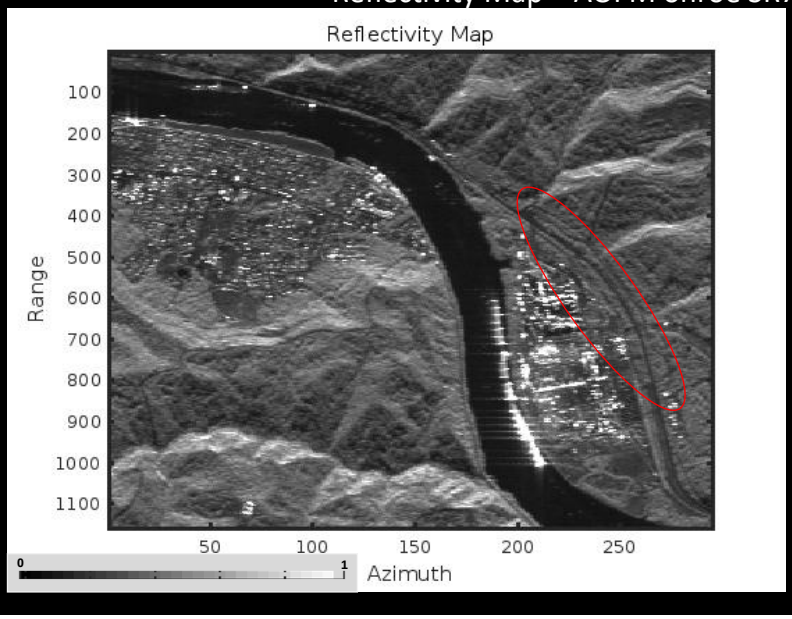
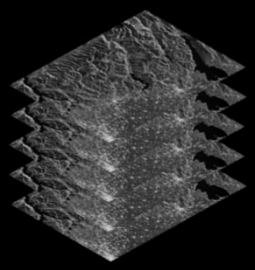
EO59

Reflectivity Map – AOI M onroe SR7



This is the amplitude mean values of radar images, representing the mean reflectivity of pixels over time.



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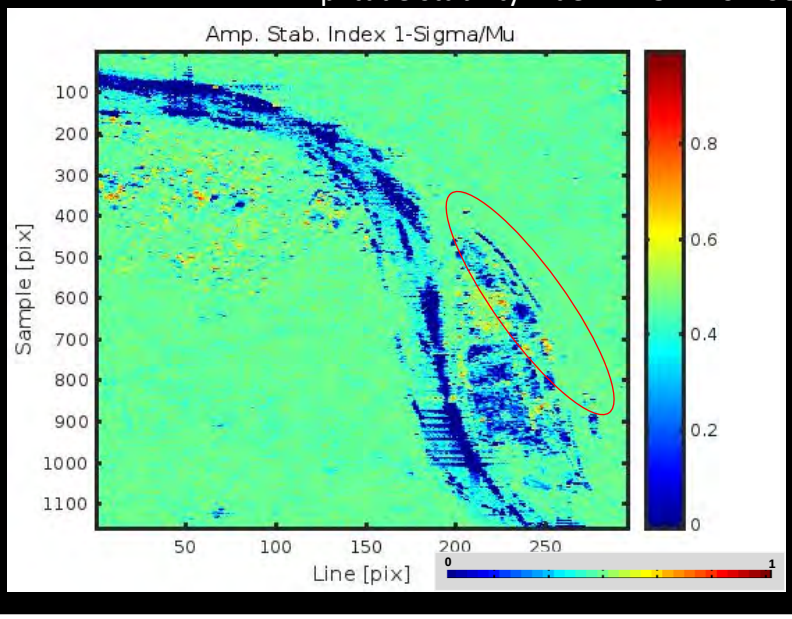
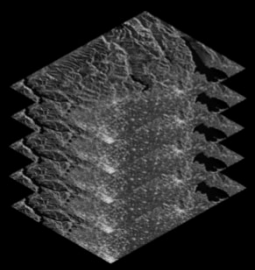
EO59

Amplitude stability index – AOI M onroe SR7



In the image on the left we have a representation of the stability of the reflectivity over time.



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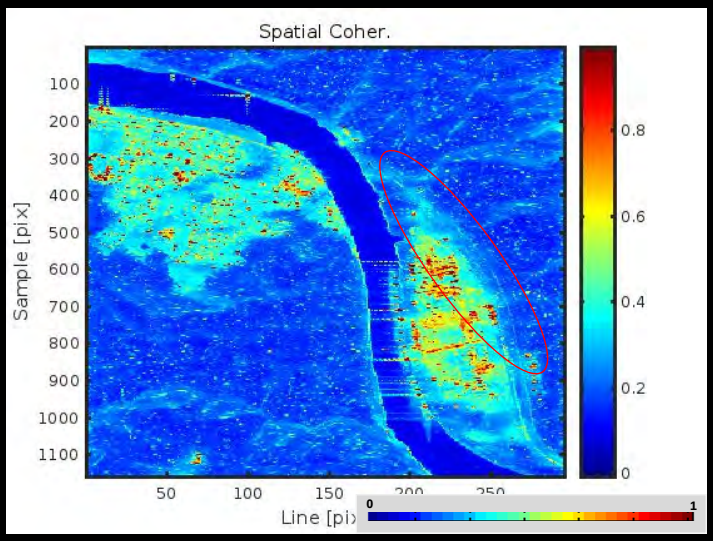
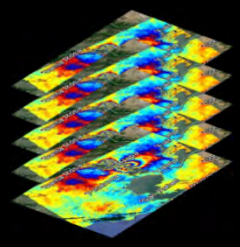
EO59

Interferometric coherence – AOI M onroe SR7



Average interferometric coherence of the interferograms.



17

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EO59

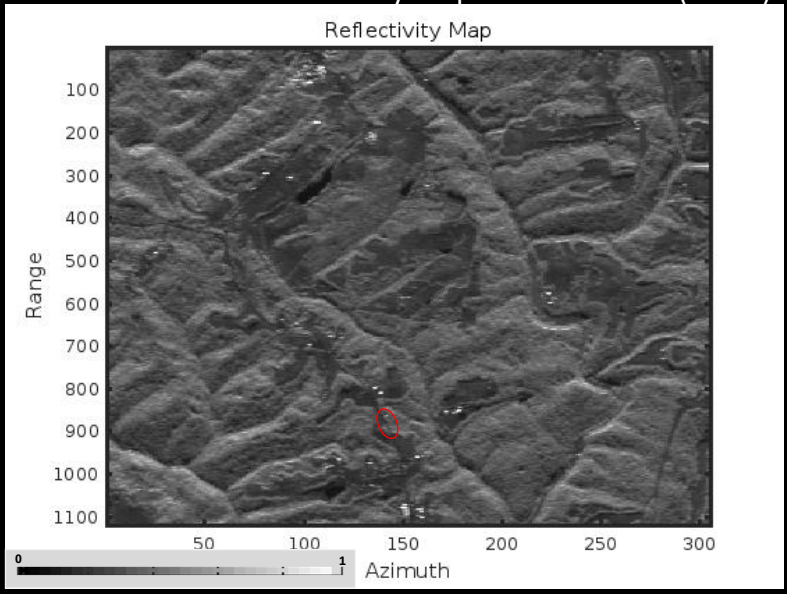
Area of interest M onroe (W est) SR78

18

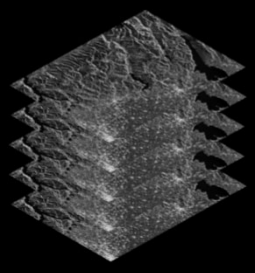
18

EO59

Reflectivity Map – AOI M onroe (W est) SR78



This is the amplitude mean values of radar images, representing the mean reflectivity of pixels over time.

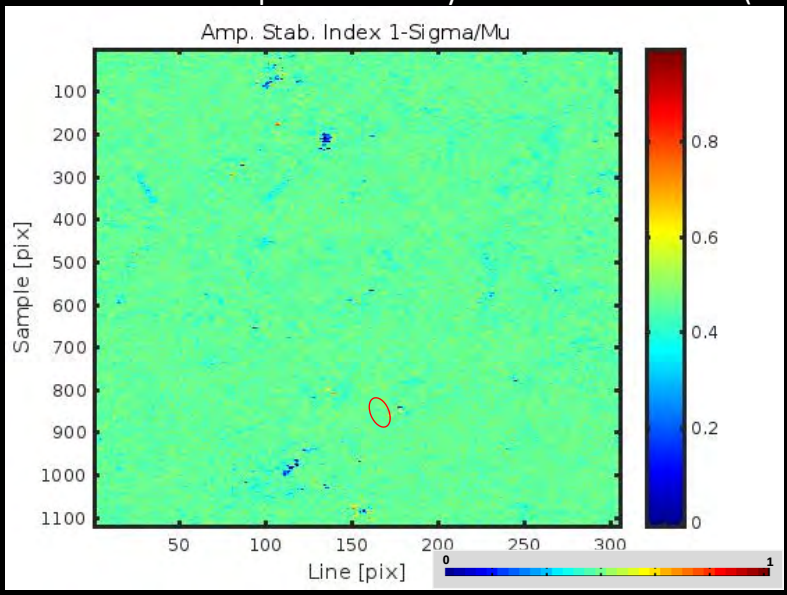


19

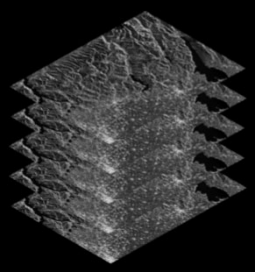
19

EO59

Amplitude stability index – AOI M onroe (W est) SR78



In the image on the left we have a representation of the stability of the reflectivity over time.

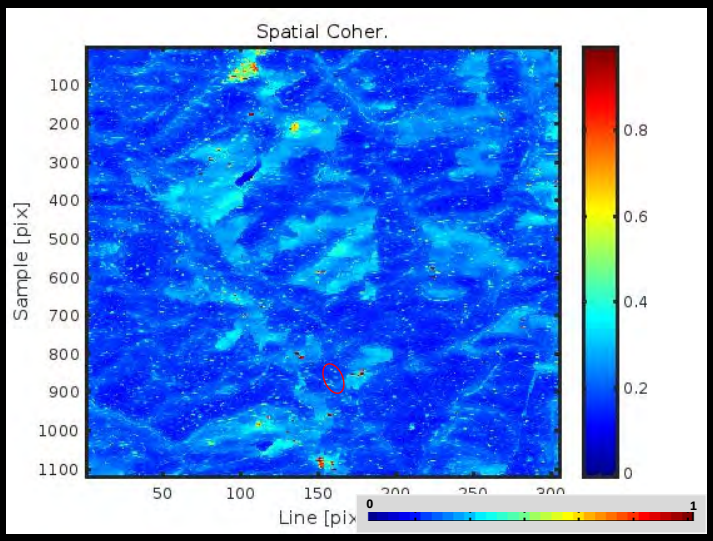


20

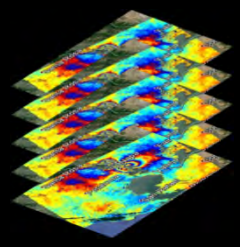
20

EO59

Interferometric coherence – AOI M onroe (W est) SR78



Average interferometric coherence of the interferograms.



21

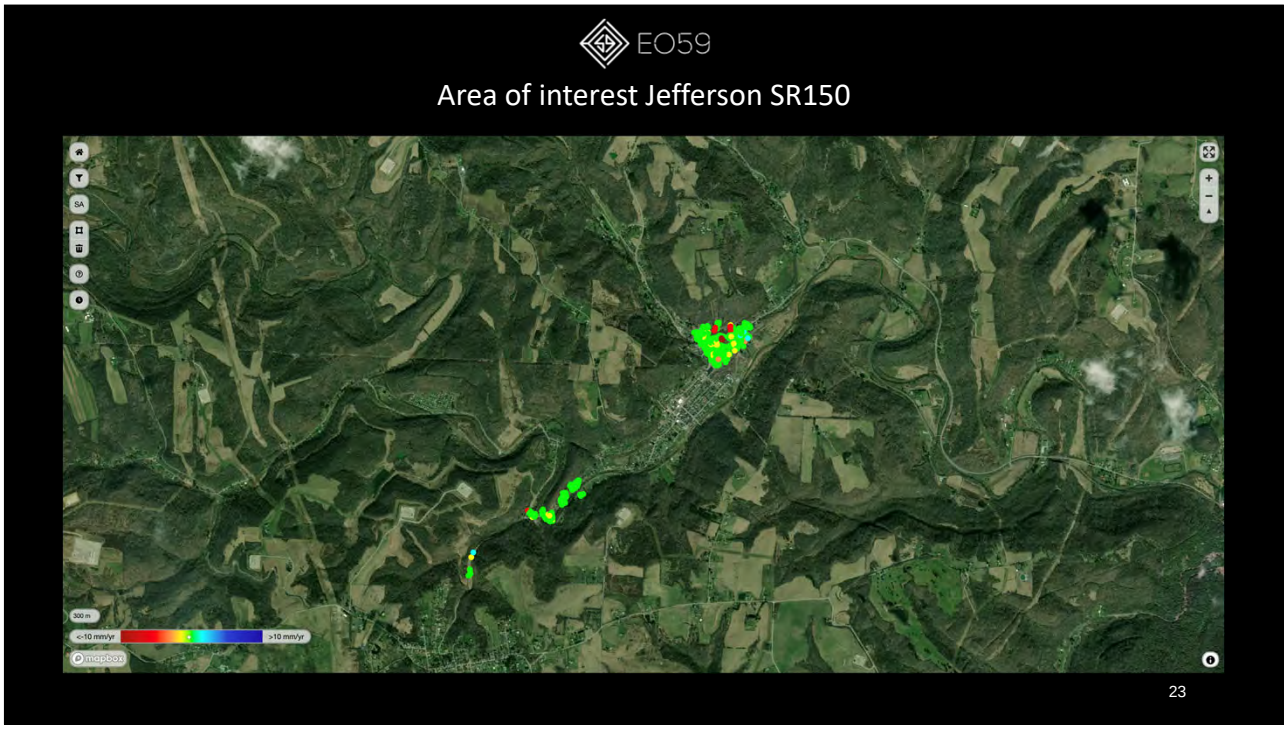
21

EO59

Area of interest Jefferson SR150

22

22


EO59
Area of interest Jefferson SR150
23

23

EO59
Area of interest Jefferson SR150
24

24

EO59

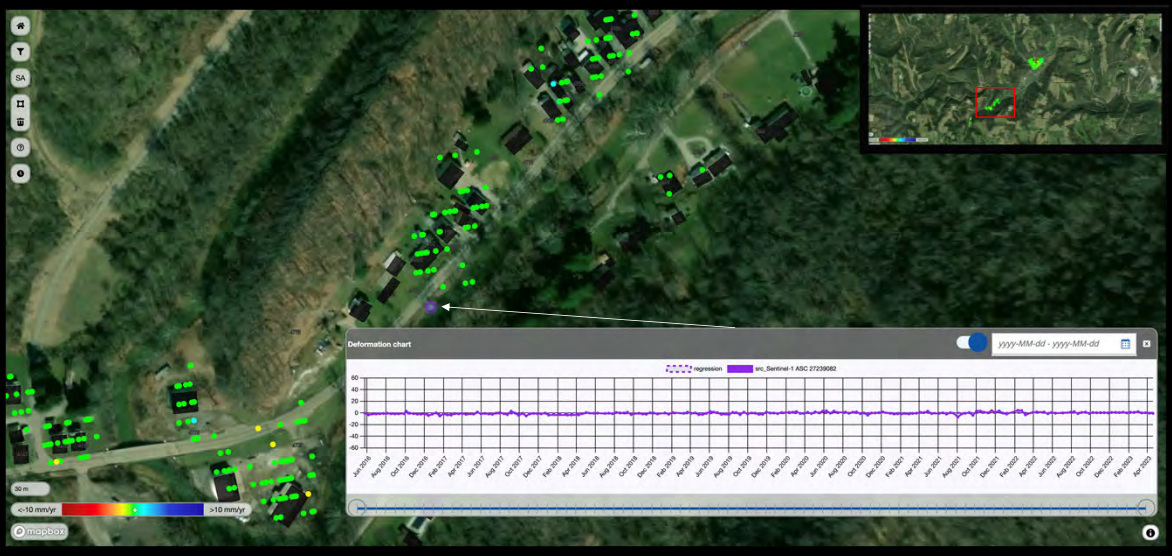
Area of interest Jefferson SR150

25

25

EO59

Area of interest Jefferson SR150

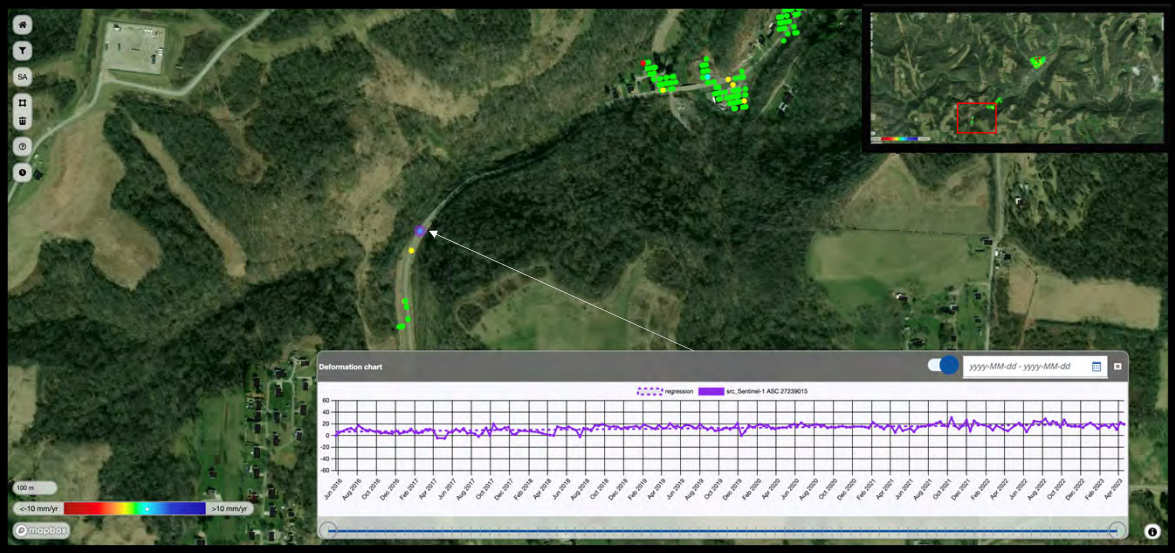


26

26

EO59

Area of interest Jefferson SR150



27

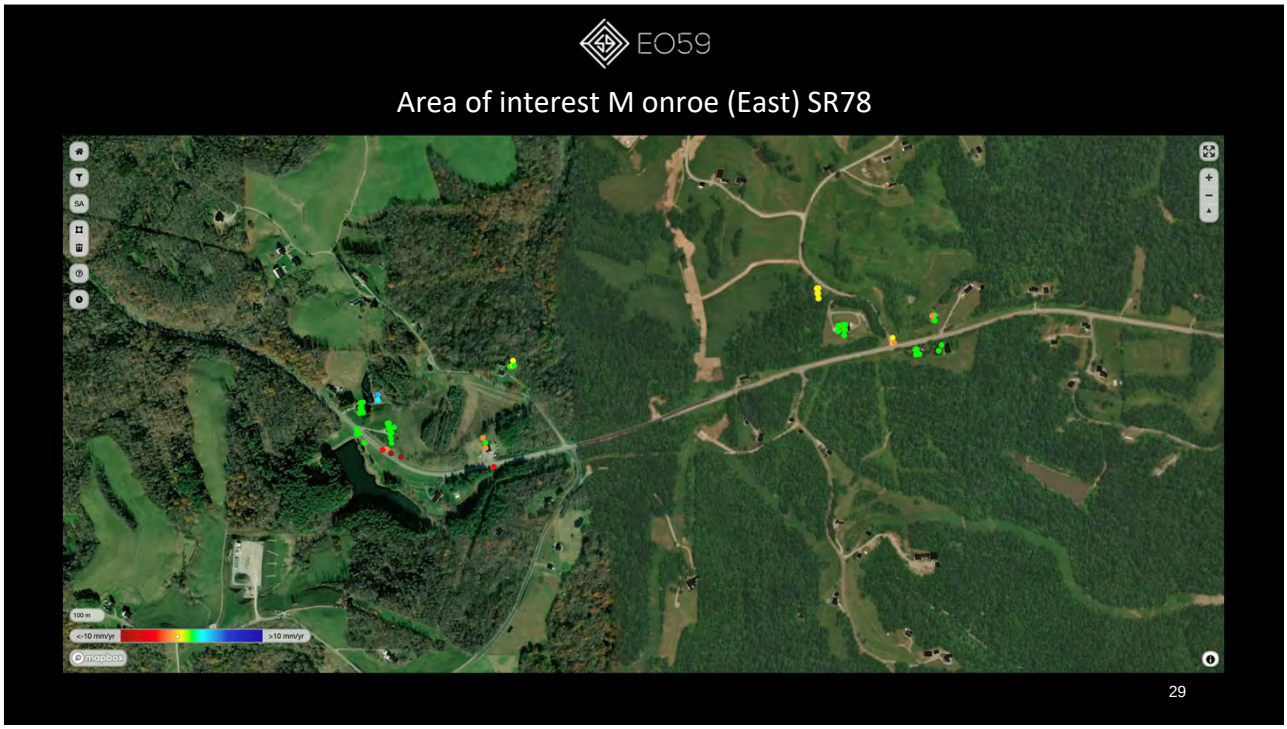
27

EO59

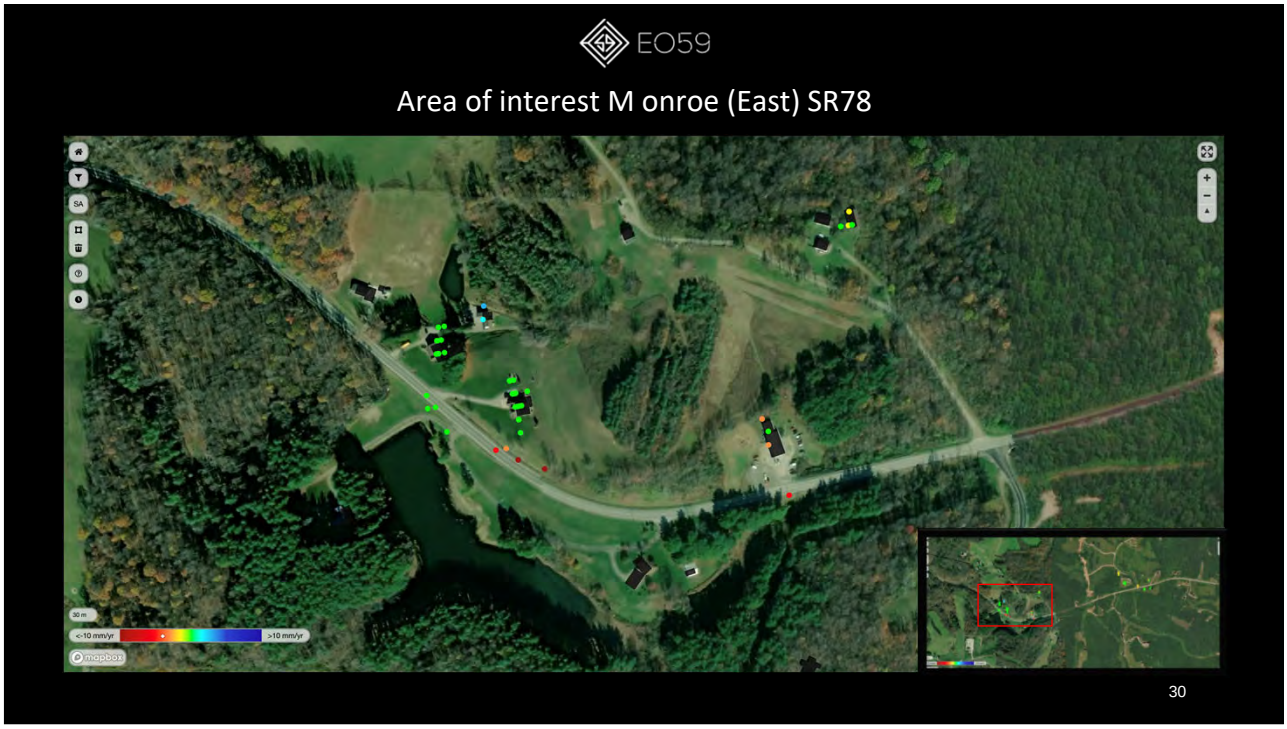
Area of interest M onroe (East) SR78

28

28


EO59
Area of interest M onroe (East) SR78
29

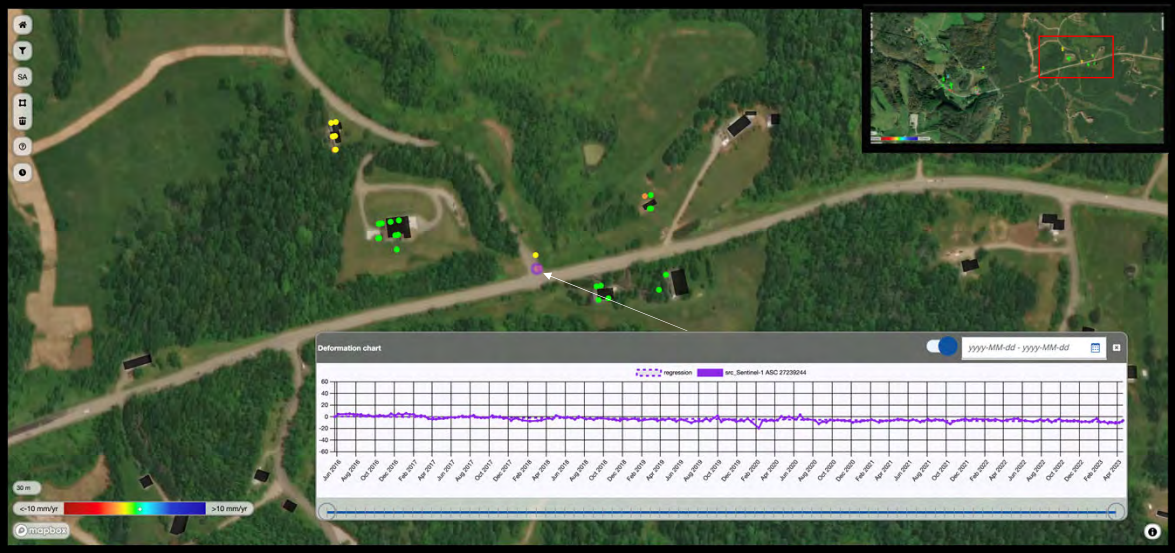
29


EO59
Area of interest M onroe (East) SR78
30

30

EO59

Area of interest M onroe (East) SR78



31

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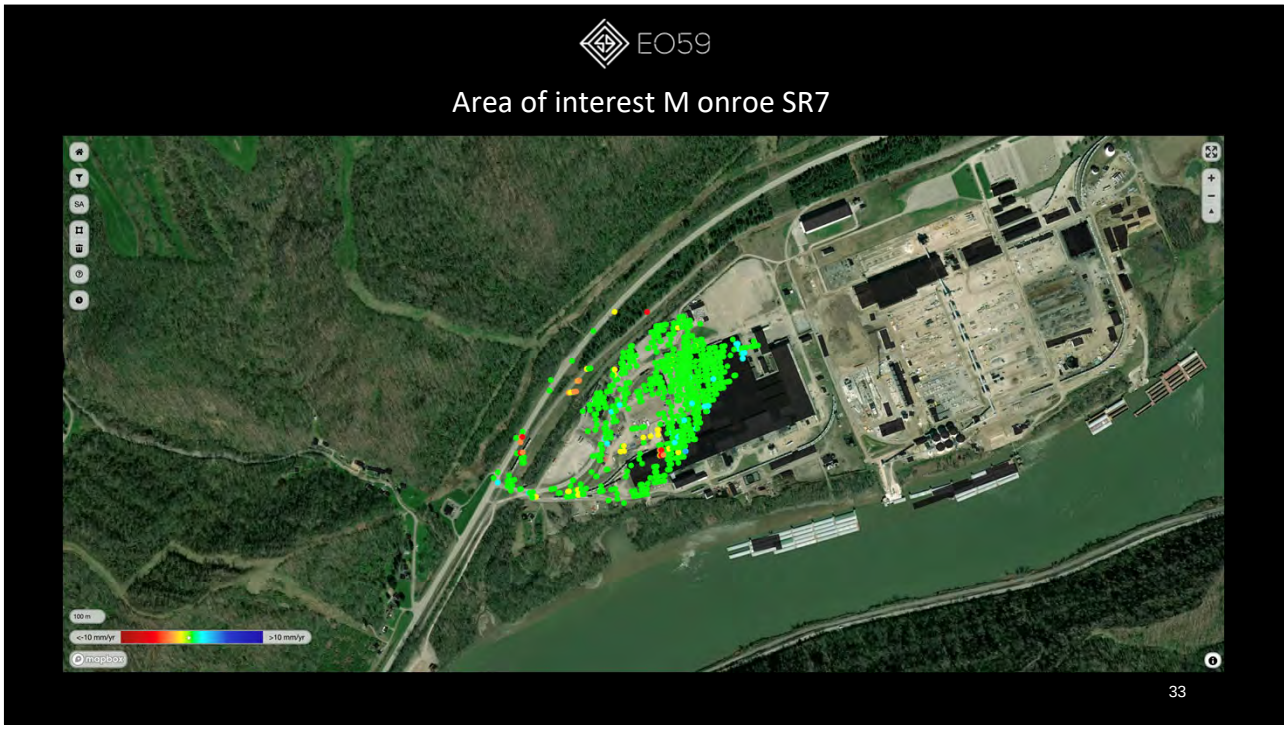
EO59

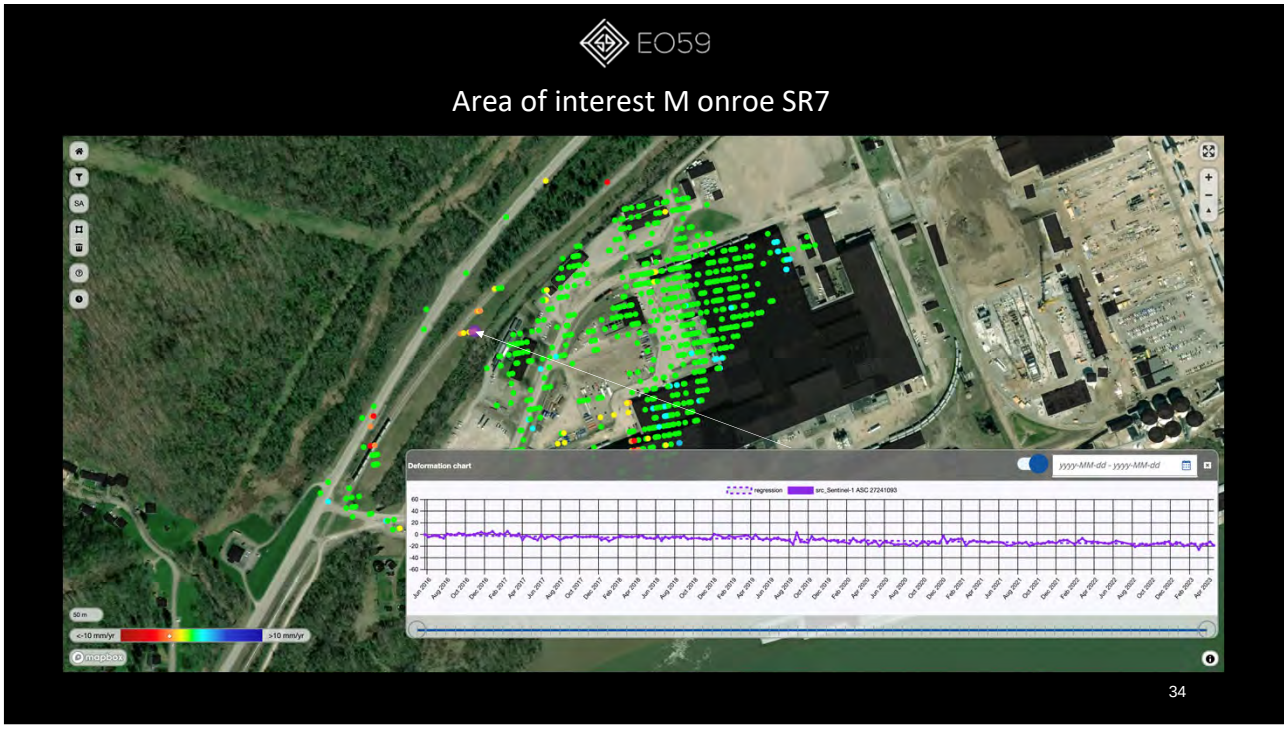
Area of interest M onroe SR7

32

32


EO59
Area of interest M onroe SR7
33

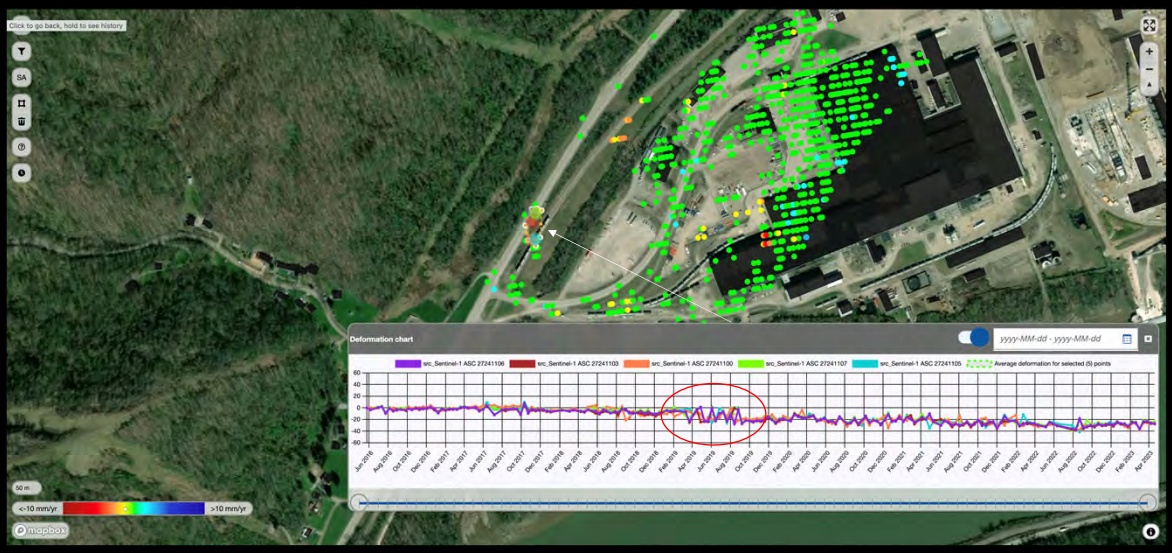
33


EO59
Area of interest M onroe SR7
Deformation chart
34

34

EO59

Area of interest M onroe SR7



35

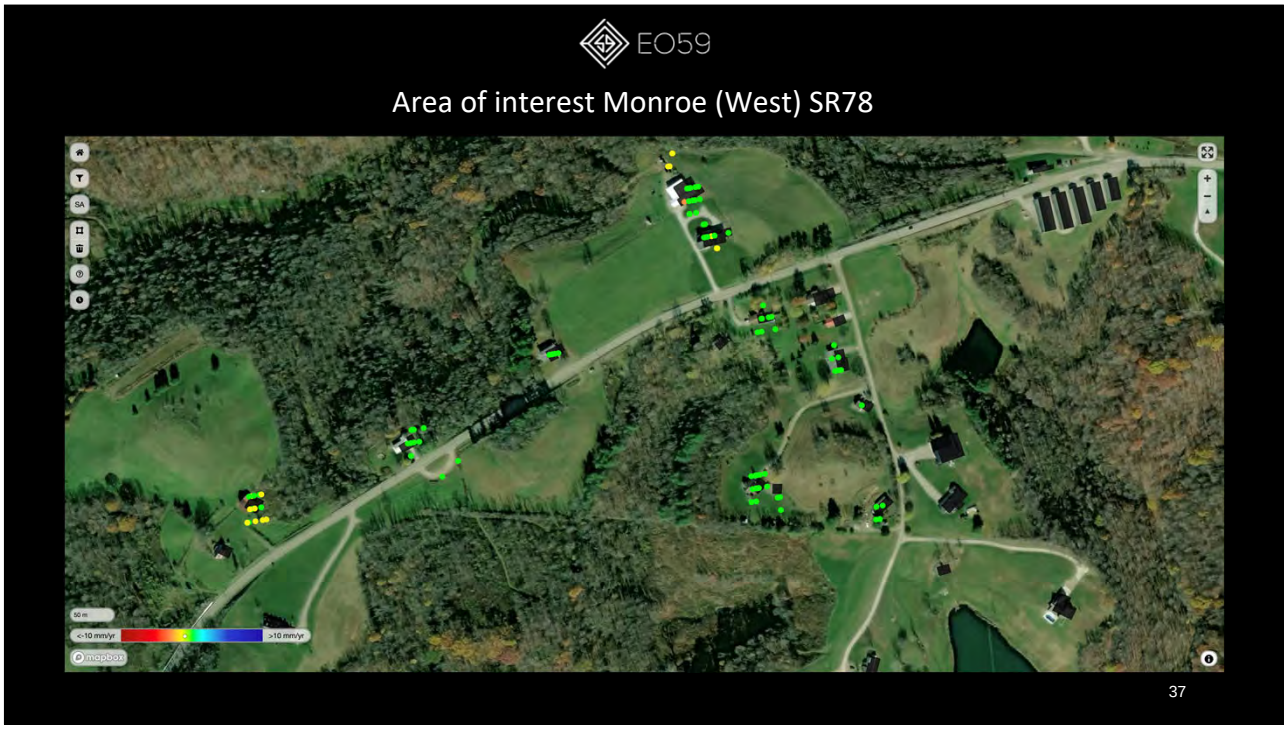
35

EO59

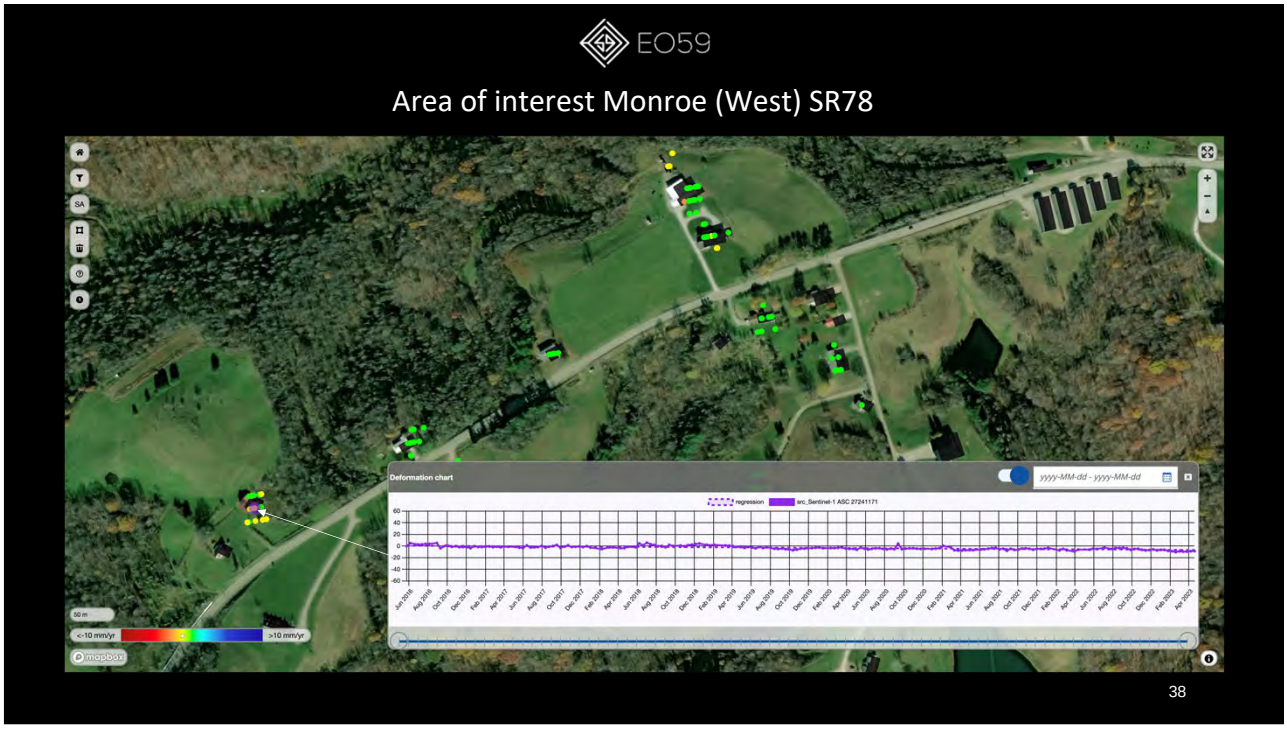
Area of interest M onroe (W est) SR78

36

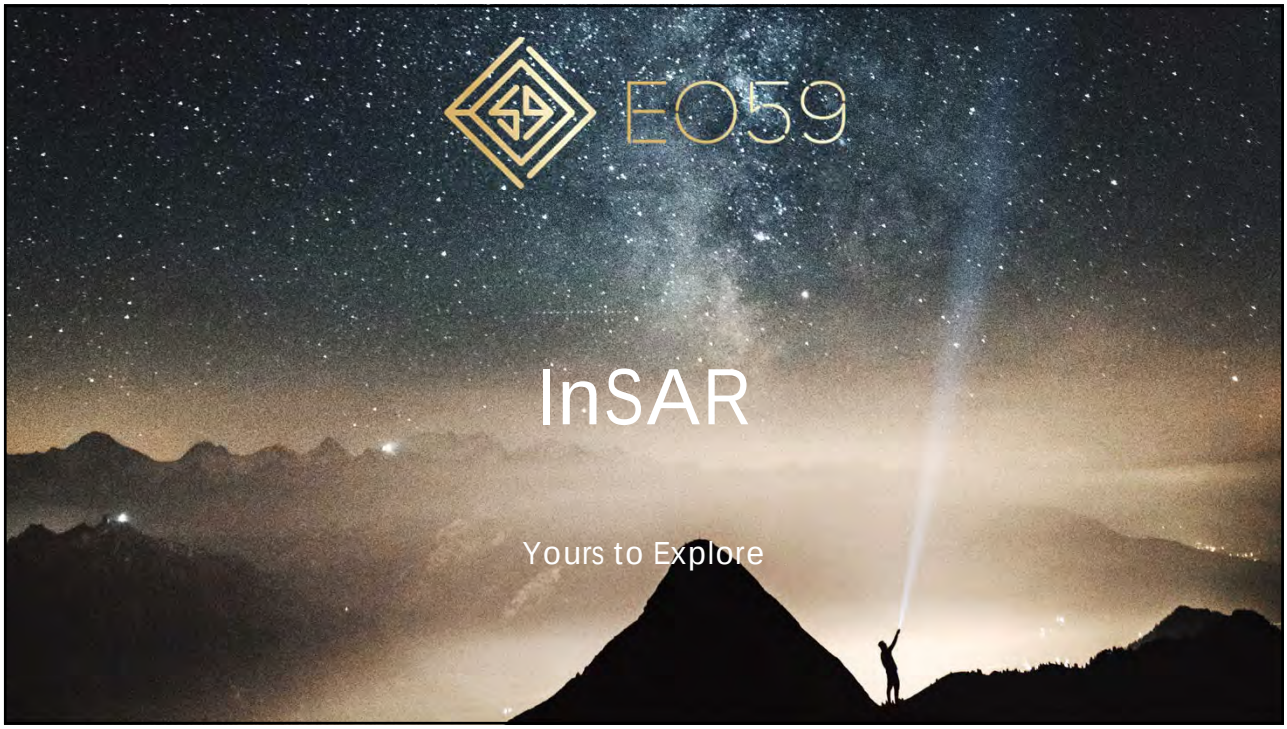
36


EO59
Area of interest Monroe (West) SR78
<-10 mm/yr
>10 mm/yr
mapbox
37

37


EO59
Area of interest Monroe (West) SR78
Deformation chart
yyyy-MM-dd - yyyy-MM-dd
<-10 mm/yr
>10 mm/yr
mapbox
38

38



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Project ODOT Remote Sensing South-East Ohio Landslides (RSSEOL)							
Landslide cluster area	**ID Landslide (ODOT)**	**EXPECTED measurement points (yes-no)**	**County**	**Route Type**	**Route Nr**	**BMP coordinate**	**EMP coordinate**
RSSEOL - Jefferson SR150							
Landslide_1	LS00008037	yes	JEFFERSON	SR	150	40.203415 -80.770031	40.203469 -80.76947
Landslide_2	LS00005475	yes	JEFFERSON	SR	150	40.188666 -80.789088	40.189304 -80.788314
Landslide_3	LS00005567	yes	JEFFERSON	SR	150	40.185671 -80.797796	40.185951 -80.797262
Landslide_4	LS00004788	yes	JEFFERSON	SR	150	40.18505 -80.798516	40.185498 -80.797979
RSSEOL - Monroe (West) SR78							
Landslide_1	LS00002018	yes	MONROE	SR	78	39.775283 -81.149394	39.775449 -81.149054
RSSEOL - Monroe (East) SR78							
Landslide_1	LS00002149	yes	MONROE	SR	78	39.750687 -81.058485	39.750187 -81.057122
Landslide_2	LS00002354	yes/no	MONROE	SR	78	39.750272 -81.054862	39.750495 -81.053491
Landslide_3	LS00002150	yes/no	MONROE	SR	78	39.750446 -81.054438	39.750611 -81.053534
Area 12E							
Landslide_4	LS00011112	no	MONROE	SR	78	39.753109 -81.043071	39.753172 -81.042519
Landslide_5	LS00002045	yes	MONROE	SR	78	39.753131 -81.042153	39.753178 -81.041925
Landslide_6	LS00005187	yes	MONROE	SR	78	39.753114 -81.042282	39.753215 -81.042032
Landslide_7	LS00002151	no	MONROE	SR	78	39.753289 -81.04183	39.753395 -81.04092
RSSEOL - Monroe SR7							
Landslide_1	LS00010377	yes	MONROE	SR	7	39.701383-80.856678	39.701747 -80.85641
Landslide_2	LS00007772	yes	MONROE	SR	7	39.70202 -80.856214	39.703697 -80.854686
Landslide_3	LS00010378	yes	MONROE	SR	7	39.704373 -80.853957	39.704677 -80.853594

APPENDIX D JEFFERSON SR 150

Id	Lat	Lon	Cumul_Vel	Cumul_disp	AU20-SP23 Cumul_vel	AU20-SP23 Cumul_disp	Stdev
27238193	40.202791	-80.772834	0.32	2.19	0.34	0.89	3.78
27238194	40.202925	-80.772778	-0.27	-1.89	-0.79	-2.06	3.61
27238195	40.20329	-80.772902	0.69	4.74	1.51	3.92	3.77
27238196	40.203413	-80.772932	0.85	5.83	1.72	4.46	3.38
27238197	40.203538	-80.772944	1.03	7.11	1.77	4.6	3.35
27238198	40.203903	-80.773066	1.69	11.66	2.45	6.35	5.67
27238199	40.201971	-80.772297	-0.12	-0.83	-0.9	-2.34	2.18
27238200	40.202105	-80.772235	-0.1	-0.7	0.74	1.91	3.38
27238201	40.202471	-80.772352	0.56	3.86	0.95	2.48	3.59
27238202	40.202977	-80.772366	1.19	8.21	0.69	1.8	5.74
27238203	40.203443	-80.77269	0.66	4.57	-0.43	-1.12	3.92
27238204	40.20356	-80.772772	0.99	6.81	0.98	2.54	5.04
27238205	40.204073	-80.772719	0.31	2.11	0.23	0.59	3.62
27238206	40.204199	-80.772728	0.27	1.84	0.07	0.17	2.41
27238207	40.204317	-80.772799	0.46	3.19	0.63	1.63	3.98
27238208	40.201392	-80.771863	0.12	0.84	0.26	0.67	4.45
27238209	40.20166	-80.771746	0.79	5.48	1.81	4.71	4.76
27238210	40.201784	-80.771765	0.3	2.1	-0.06	-0.15	3.29
27238211	40.201898	-80.771866	-0.74	-5.09	-3.41	-8.86	4.97
27238212	40.202022	-80.77189	0.12	0.85	0.51	1.32	2.55
27238213	40.202392	-80.771973	-0.17	-1.19	-0.57	-1.47	1.97
27238214	40.202518	-80.771981	0.01	0.09	-0.74	-1.93	1.75
27238215	40.202639	-80.772024	0.53	3.67	-0.82	-2.12	2.47
27238216	40.202763	-80.772044	-0.79	-5.42	-0.19	-0.49	3.08
27238217	40.203492	-80.772305	0.09	0.63	0.11	0.29	4.05
27238218	40.203623	-80.772269	0.24	1.65	0.18	0.47	3.96
27238219	40.20375	-80.772267	0.29	2.02	0.57	1.48	4.45
27238220	40.201205	-80.771326	-0.71	-4.91	0.55	1.43	5.13
27238221	40.201329	-80.77135	0.34	2.37	-0.52	-1.35	2.57
27238222	40.20146	-80.771316	0.51	3.49	-0.53	-1.37	2.06
27238223	40.201592	-80.771273	0.48	3.33	0.72	1.86	5.27
27238224	40.202197	-80.771502	-0.49	-3.41	-2.02	-5.24	4.99
27238225	40.203067	-80.771646	-1.38	-9.55	-3.3	-8.57	4.03
27238226	40.203191	-80.771669	-1.07	-7.38	-2.51	-6.51	3.49
27238227	40.203311	-80.771722	-0.96	-6.6	-2.68	-6.95	4.22
27238228	40.202385	-80.77102	-0.12	-0.8	-1.67	-4.33	4.21
27238229	40.202509	-80.77104	0.14	0.98	-0.71	-1.84	2.52
27238230	40.202629	-80.771097	0.17	1.2	0.26	0.68	2.18
27238231	40.202748	-80.771159	0.54	3.7	1.22	3.16	2.73
27238232	40.202866	-80.771224	0.01	0.04	0.37	0.96	3.17
27238233	40.203	-80.771168	-1.11	-7.68	-0.25	-0.66	3.9
27238234	40.203243	-80.771255	0.39	2.7	1.16	3	4.85
27238235	40.201584	-80.770327	0.07	0.51	-0.49	-1.28	4.17
27238236	40.201696	-80.770442	-0.23	-1.57	-0.36	-0.93	1.62
27238237	40.201821	-80.770459	0	0	0.18	0.48	1.41
27238238	40.201946	-80.770476	0.27	1.83	0.19	0.48	1.71
27238239	40.202082	-80.770396	-0.18	-1.27	-0.48	-1.24	4.96
27238240	40.203556	-80.770777	-0.43	-2.99	-1.69	-4.38	4.63
27238241	40.202622	-80.769126	-0.77	-5.31	-3.37	-8.74	3.41
27238242	40.202754	-80.769082	-0.17	-1.17	-2.64	-6.86	3.02
27238243	40.202887	-80.769039	0.68	4.7	1.06	2.74	4.32
27238244	40.202391	-80.768945	0.11	0.75	0.26	0.66	5.15
27238245	40.202525	-80.768885	0.14	0.95	0.21	0.54	5.23
27238246	40.202632	-80.769049	-0.12	-0.85	-0.99	-2.56	3.96
27238247	40.202767	-80.768979	-0.22	-1.51	-0.9	-2.33	2.63
27238248	40.203496	-80.769235	0.16	1.09	-0.99	-2.56	5.18
27238249	40.203545	-80.768843	0.2	1.39	1.22	3.17	5.11
27238250	40.203803	-80.768812	0.66	4.58	1.07	2.78	4.47
27238251	40.203933	-80.768783	0.66	4.57	0.59	1.52	2.98
27238252	40.204064	-80.768752	0.51	3.55	-0.08	-0.2	3.99
27238253	40.203247	-80.768183	-0.04	-0.3	1.01	2.62	4.97
27238254	40.203464	-80.768481	1.6	11.06	4.19	10.87	6.27
27238255	40.203603	-80.768382	0.83	5.7	-0.69	-1.78	3.9
27238256	40.203732	-80.768362	0.69	4.78	-0.6	-1.56	3.88
27238257	40.203484	-80.768318	0.15	1.06	-0.44	-1.15	3.42
27238258	40.203619	-80.768256	0.31	2.17	-0.15	-0.39	2.84
27238259	40.203743	-80.768275	0.37	2.58	-0.21	-0.55	3.48
27238260	40.204281	-80.768026	-0.17	-1.2	2.6	6.74	5.09

27238261	40.20334	-80.77351	0.04	0.25	-1.62	-4.2	2.43
27238262	40.203468	-80.773503	-0.45	-3.12	-1.25	-3.25	3.19
27238263	40.203603	-80.773439	0.58	4.02	2.42	6.27	5.31
27238264	40.203718	-80.773535	0.07	0.46	0.23	0.59	2.58
27238265	40.203847	-80.773511	0.06	0.42	-1.62	-4.19	4.08
27238266	40.203291	-80.772889	0.55	3.78	1.33	3.45	3.76
27238267	40.203415	-80.772913	0.81	5.57	1.66	4.3	3.35
27238268	40.203538	-80.772943	1.05	7.22	1.8	4.68	3.27
27238269	40.203649	-80.773074	0.14	0.93	-2.43	-6.3	4.55
27238270	40.20391	-80.773011	1.3	8.97	2.03	5.28	5.8
27238271	40.202799	-80.77277	-0.1	-0.69	-1.12	-2.92	2.3
27238272	40.202925	-80.772781	0.21	1.42	-0.38	-0.99	1.8
27238273	40.203419	-80.772883	0.88	6.08	1.73	4.5	3.53
27238274	40.203543	-80.772902	1.29	8.88	1.15	2.98	3.83
27238275	40.200953	-80.771318	0.26	1.79	-1.05	-2.73	3.9
27238276	40.201329	-80.771349	0.11	0.78	0.78	2.02	4.86
27238277	40.202681	-80.771692	-0.75	-5.2	2.24	5.81	5.55
27238278	40.202794	-80.771803	0.52	3.6	0.04	0.1	3.8
27238279	40.202915	-80.771845	0.72	5	0.28	0.72	3.21
27238280	40.203045	-80.771818	0.73	5.05	4.71	12.24	4.59
27238281	40.201616	-80.771083	-1.48	-10.23	-0.66	-1.71	5.75
27238282	40.201741	-80.771094	-0.72	-4.97	-0.68	-1.77	3.69
27238283	40.201858	-80.771172	-0.05	-0.33	-0.99	-2.56	4.4
27238284	40.201989	-80.77114	0.21	1.45	1.71	4.44	4.72
27238285	40.202955	-80.771532	-0.6	-4.15	0.46	1.2	4.95
27238286	40.20309	-80.771459	-0.41	-2.85	-0.48	-1.24	3.67
27238287	40.203222	-80.771417	-0.23	-1.62	0.41	1.06	4.78
27238288	40.201791	-80.770696	0.23	1.61	1.27	3.29	4.26
27238289	40.201926	-80.770631	0.27	1.89	-0.39	-1.02	4.49
27238290	40.202056	-80.770604	0.66	4.54	-0.8	-2.08	4.65
27238291	40.202295	-80.770725	0.18	1.26	0.22	0.58	3.6
27238292	40.202414	-80.770788	0.34	2.36	-1.06	-2.75	3.44
27238293	40.202057	-80.770602	-0.07	-0.46	-1.5	-3.89	4.03
27238294	40.202296	-80.770719	0.34	2.32	0.33	0.86	4.6
27238295	40.202423	-80.77071	-0.1	-0.66	1.88	4.87	4.99
27238296	40.202663	-80.770823	0.4	2.78	0.38	0.98	3.22
27238297	40.203146	-80.77102	0.92	6.34	0.65	1.69	3.76
27238298	40.203275	-80.770999	1.41	9.71	0.69	1.79	4.72
27238299	40.204524	-80.771146	0.83	5.75	0.1	0.25	5.56
27238300	40.204649	-80.771164	1.03	7.12	0.39	1.02	5.66
27238301	40.201499	-80.769996	-0.9	-6.21	1.1	2.86	5.11
27238302	40.201975	-80.770244	-0.8	-5.52	0.6	1.56	5.03
27238303	40.202109	-80.770181	-0.86	-5.94	1.13	2.93	4.8
27238304	40.201911	-80.769744	0.6	4.14	0.37	0.95	4.63
27238305	40.202032	-80.769789	0.85	5.84	4.75	12.33	5.54
27238306	40.202691	-80.769583	0.43	2.99	-2.68	-6.95	4.57
27238307	40.202594	-80.769349	0.46	3.17	-2.17	-5.64	3.57
27238308	40.202722	-80.76934	-1.01	-6.93	-4.75	-12.32	3.92
27238309	40.202844	-80.769381	-1.55	-10.65	-7.36	-19.1	5.23
27238310	40.202353	-80.769251	-2.06	-14.2	-3.17	-8.23	5.1
27238311	40.202494	-80.769138	0.24	1.63	-2.12	-5.51	4.26
27238312	40.202617	-80.769165	0.53	3.65	-2.06	-5.35	3.6
27238313	40.20274	-80.769197	0.53	3.64	-1.91	-4.97	3.57
27238314	40.202864	-80.769221	0.27	1.86	-4.31	-11.18	4.28
27238315	40.202996	-80.769178	-0.48	-3.29	-4.01	-10.4	3.57
27238316	40.203502	-80.769235	0.89	6.17	1.71	4.45	1.73
27238317	40.203627	-80.769251	0.93	6.39	1.79	4.66	1.43
27238318	40.203816	-80.768709	1.09	7.49	0.05	0.13	5.33
27238319	40.203937	-80.76875	1.11	7.63	0.25	0.66	4.6
27238320	40.204061	-80.768775	0.99	6.85	0.44	1.15	5.45
27238321	40.203949	-80.768658	0.96	6.64	1.11	2.87	5.24
27238322	40.204074	-80.768668	0.69	4.74	1.7	4.42	4.62
27238323	40.203012	-80.768036	-3.72	-25.66	-1.94	-5.04	8.85
27238324	40.20314	-80.76803	-3.55	-24.53	-2.78	-7.22	8.97
27238325	40.203671	-80.76784	1.32	9.12	2.39	6.2	5.68
27238326	40.204339	-80.767567	-0.11	-0.75	0.17	0.45	4.91
27238327	40.203816	-80.773764	-0.24	-1.64	0.03	0.09	4.2
27238328	40.203119	-80.77325	0.96	6.64	1.42	3.69	5.2
27238329	40.203375	-80.773236	-0.13	-0.87	-0.19	-0.5	2.84

27238330	40.2035	-80.773246	0.22	1.51	0.04	0.1	3.88
27238331	40.20314	-80.773087	-0.34	-2.37	0.86	2.24	4.95
27238332	40.203398	-80.773048	0.89	6.16	1.16	3.02	4.26
27238333	40.203526	-80.773041	1.01	6.94	1.49	3.85	4.05
27238334	40.202438	-80.772619	-0.28	-1.94	-0.7	-1.82	4.91
27238335	40.202805	-80.772727	-0.07	-0.5	-0.67	-1.73	1.65
27238336	40.202928	-80.772754	0.04	0.26	-0.7	-1.82	1.46
27238337	40.203293	-80.772874	-0.29	-2.02	-2.73	-7.09	4.58
27238338	40.202441	-80.772594	-0.6	-4.16	-2.73	-7.08	4.93
27238339	40.202572	-80.772561	-1.41	-9.73	-2.48	-6.45	5.59
27238340	40.202699	-80.772559	-0.93	-6.38	-1.29	-3.34	5.17
27238341	40.20281	-80.772684	-0.07	-0.5	-1.02	-2.65	2.1
27238342	40.202931	-80.772731	-0.13	-0.87	-0.91	-2.36	1.55
27238343	40.203315	-80.772701	0.86	5.96	0.55	1.42	5.25
27238344	40.202445	-80.772562	-0.98	-6.73	-2.8	-7.26	4.53
27238345	40.20257	-80.772575	-0.92	-6.37	-1.97	-5.1	4.75
27238346	40.202697	-80.77257	-0.87	-6.03	-1.66	-4.31	4.75
27238347	40.202823	-80.772577	-0.66	-4.53	-0.92	-2.39	4.67
27238348	40.202947	-80.772602	0.38	2.62	-0.07	-0.17	4.86
27238349	40.203319	-80.772669	-0.19	-1.3	-0.73	-1.88	4.98
27238350	40.201534	-80.771736	1.15	7.92	1.45	3.76	5.29
27238351	40.201657	-80.771764	0.55	3.8	0.11	0.29	3.16
27238352	40.201781	-80.771791	0.39	2.72	-0.85	-2.21	2.85
27238353	40.201903	-80.771828	-1.38	-9.54	-5.14	-13.34	5.97
27238354	40.202022	-80.771891	0.1	0.71	1.03	2.68	2.39
27238355	40.202397	-80.771936	-0.21	-1.47	-0.96	-2.5	1.7
27238356	40.202522	-80.771949	0.01	0.06	-0.61	-1.59	1.6
27238357	40.202645	-80.771974	0.36	2.51	-0.63	-1.63	2.12
27238358	40.202761	-80.772063	-0.36	-2.48	-0.22	-0.58	2.82
27238359	40.203762	-80.772173	-0.85	-5.87	-0.5	-1.31	5.16
27238360	40.201527	-80.771792	0.51	3.51	-2.6	-6.75	4.83
27238361	40.201646	-80.771852	0.82	5.63	-1.17	-3.04	4.18
27238362	40.202285	-80.771814	-4.56	-31.42	-2.82	-7.31	12.48
27238363	40.202405	-80.771867	-0.11	-0.73	-0.52	-1.36	2.04
27238364	40.202529	-80.771893	0.23	1.58	0.42	1.1	2.06
27238365	40.202653	-80.771913	0.46	3.17	0.94	2.44	3.09
27238366	40.20097	-80.771182	0.32	2.18	1.49	3.86	5.3
27238367	40.201107	-80.771099	0.13	0.89	2.36	6.13	3.99
27238368	40.201341	-80.771253	0.27	1.84	-0.75	-1.96	2.52
27238369	40.201464	-80.771283	0.51	3.53	-0.37	-0.96	2.01
27238370	40.201588	-80.771305	0.52	3.59	1.33	3.44	3.03
27238371	40.20196	-80.77137	0.68	4.67	-0.4	-1.04	4.48
27238372	40.202946	-80.771602	-0.76	-5.22	-1.27	-3.3	5.53
27238373	40.203071	-80.771612	-1.31	-9.03	-3.04	-7.88	4.19
27238374	40.203193	-80.77165	-1.26	-8.69	-3.2	-8.31	3.94
27238375	40.203323	-80.771622	-1.06	-7.34	-1.89	-4.91	4.95
27238376	40.200975	-80.771138	-0.17	-1.2	-0.77	-2.01	4.26
27238377	40.201102	-80.771134	0.38	2.65	1.5	3.88	3.19
27238378	40.201341	-80.771254	0.25	1.72	-0.41	-1.06	4.26
27238379	40.201467	-80.771262	0.32	2.21	-0.91	-2.35	2.41
27238380	40.201584	-80.771338	0.6	4.13	1.44	3.74	2.52
27238381	40.201719	-80.771273	0.73	5.05	2.2	5.71	4.64
27238382	40.201965	-80.771336	0.78	5.39	0.31	0.8	5.16
27238383	40.202259	-80.771007	-0.52	-3.57	-1.81	-4.68	5.3
27238384	40.202372	-80.771121	0.55	3.76	-1.49	-3.86	4.47
27238385	40.202507	-80.771053	0.43	2.97	-0.64	-1.65	2.47
27238386	40.202632	-80.77107	0.37	2.56	0.8	2.07	2.66
27238387	40.202741	-80.771213	1.07	7.4	0.27	0.7	5.02
27238388	40.202867	-80.771222	0.65	4.48	-0.22	-0.57	4.53
27238389	40.202999	-80.771175	-0.2	-1.39	-1.02	-2.65	3.78
27238390	40.202893	-80.771009	1.93	13.32	1.3	3.36	5.92
27238391	40.20172	-80.770257	0.75	5.17	2.13	5.54	4.12
27238392	40.203442	-80.770681	-3.52	-24.26	-3.74	-9.72	8.65
27238393	40.201594	-80.770249	0.29	2.02	1	2.59	3.41
27238394	40.20171	-80.770337	0.36	2.45	1.72	4.46	4.32
27238395	40.202598	-80.77033	0.44	3.04	0.25	0.66	3.77
27238396	40.203453	-80.770587	-3.67	-25.31	-3.05	-7.92	8.61
27238397	40.203474	-80.770428	0.26	1.77	0.98	2.56	5.28
27238398	40.202352	-80.769258	0.72	4.96	1.39	3.61	4.94

27238399	40.20247	-80.76933	-0.8	-5.51	-0.59	-1.54	4
27238400	40.202607	-80.769243	0.49	3.39	0.89	2.32	3.39
27238401	40.202738	-80.769212	0.38	2.63	0.27	0.69	3.9
27238402	40.20298	-80.769306	1.57	10.83	4.65	12.06	4.82
27238403	40.203221	-80.769402	0.94	6.5	0.59	1.53	4.81
27238404	40.203476	-80.769392	0.87	6	1.62	4.2	5.47
27238405	40.203582	-80.76956	0.88	6.04	2.08	5.39	4.69
27238406	40.203711	-80.769544	0.25	1.75	0.69	1.78	4.62
27238407	40.204459	-80.769645	-2.56	-17.66	-0.2	-0.51	7.26
27238408	40.202401	-80.768868	-0.06	-0.44	1.15	2.98	4.71
27238409	40.202535	-80.768807	0.03	0.18	0.76	1.98	5.31
27238410	40.202617	-80.769171	0.52	3.6	-2.55	-6.61	4.87
27238411	40.202758	-80.769053	-0.39	-2.66	-1.75	-4.53	3.42
27238412	40.203024	-80.76895	1.17	8.05	-0.32	-0.82	4.77
27238413	40.202948	-80.768546	0.26	1.81	2.52	6.54	4.44
27238414	40.203078	-80.768522	0.45	3.12	0.8	2.08	2.9
27238415	40.203936	-80.768759	0.32	2.24	-0.07	-0.19	4.78
27238416	40.203936	-80.768759	0.42	2.87	0.04	0.09	4.62
27238417	40.202617	-80.768152	0.88	6.06	0.44	1.13	5.39
27238418	40.203488	-80.768286	0.54	3.71	0.31	0.82	4.9
27238419	40.203624	-80.768212	0.59	4.06	0.32	0.84	2.98
27238420	40.203746	-80.76825	0.96	6.61	0.09	0.23	3.36
27238421	40.20387	-80.768269	1.02	7.05	1.04	2.7	4.85
27238422	40.203976	-80.768438	1.47	10.13	-0.22	-0.57	6.08
27238423	40.203615	-80.768289	0.52	3.56	0.34	0.89	4.56
27238424	40.203743	-80.768273	0.8	5.53	1.11	2.89	3.51
27238425	40.203875	-80.76823	0.79	5.43	1.71	4.42	4.39
27238426	40.204234	-80.767393	0.45	3.09	-0.97	-2.52	4.06
27238427	40.204357	-80.76742	0.61	4.22	0.11	0.28	2.42
27238428	40.202909	-80.772907	0.15	1.06	-0.34	-0.87	3.97
27238429	40.203393	-80.773088	0.66	4.58	1.37	3.54	2.93
27238430	40.203523	-80.773062	0.46	3.19	0.64	1.67	2.49
27238431	40.202087	-80.77238	-0.46	-3.17	-0.46	-1.19	3.45
27238432	40.202214	-80.772378	-0.43	-2.99	-0.81	-2.11	3.03
27238433	40.204069	-80.772757	-0.87	-5.99	-1.37	-3.56	5.53
27238434	40.204194	-80.772771	0.18	1.27	0.87	2.25	2.14
27238435	40.204321	-80.77277	0.39	2.67	1.2	3.11	2.22
27238436	40.202084	-80.772408	-0.72	-4.94	-2.09	-5.43	4.35
27238437	40.202214	-80.772381	-0.57	-3.92	-2.35	-6.09	3.5
27238438	40.202469	-80.772373	0.98	6.74	0.35	0.9	5.36
27238439	40.202831	-80.772519	0.63	4.33	0.6	1.55	4.7
27238440	40.202964	-80.772464	0.86	5.9	1.19	3.09	3.41
27238441	40.203448	-80.772649	-0.2	-1.41	-1.16	-3.02	3.15
27238442	40.203581	-80.772601	0.06	0.39	-1.01	-2.63	3.22
27238443	40.204071	-80.77274	0.11	0.78	-0.22	-0.57	3.6
27238444	40.204196	-80.772755	-0.08	-0.52	-0.12	-0.32	2.26
27238445	40.204321	-80.77277	0.32	2.24	1.32	3.43	2.21
27238446	40.201528	-80.771782	0.16	1.13	1.17	3.04	3.9
27238447	40.201773	-80.771855	0.68	4.7	1.39	3.61	2.53
27238448	40.201899	-80.77186	0.8	5.55	0.62	1.61	3.03
27238449	40.202015	-80.771949	0.25	1.75	-1.12	-2.9	5.35
27238450	40.20227	-80.771933	0.41	2.85	-0.79	-2.05	3.44
27238451	40.202394	-80.771955	0.03	0.22	-0.5	-1.29	3.18
27238452	40.202509	-80.772048	-0.44	-3.02	-1.22	-3.18	2.64
27238453	40.202632	-80.772081	-1.16	-8.03	-2.14	-5.55	4.37
27238454	40.203492	-80.772304	-0.25	-1.7	-1.27	-3.29	2.46
27238455	40.20362	-80.772294	-0.25	-1.71	-1.09	-2.82	2.36
27238456	40.203877	-80.772264	-2.91	-20.09	-1.17	-3.03	7.75
27238457	40.201401	-80.771783	-0.29	-1.97	2.44	6.32	4
27238458	40.201531	-80.771763	-0.6	-4.13	0.58	1.5	4.06
27238459	40.201783	-80.77177	0.68	4.72	1.33	3.45	3.9
27238460	40.201906	-80.771801	0.56	3.89	-0.92	-2.4	3.72
27238461	40.202277	-80.771877	0.71	4.9	1.08	2.8	4.39
27238462	40.202393	-80.771965	0.21	1.43	0.49	1.27	2.32
27238463	40.202511	-80.772033	-0.1	-0.66	-0.9	-2.34	2.08
27238464	40.202632	-80.772078	0.09	0.64	-0.28	-0.73	3.27
27238465	40.202769	-80.771997	-2	-13.79	-0.96	-2.5	4.86
27238466	40.202994	-80.772232	0.76	5.26	-2.2	-5.7	5.27
27238467	40.203494	-80.772286	-0.05	-0.34	-0.29	-0.76	2.78

27238468	40.203623	-80.772271	0.06	0.39	0	-0.01	3.1
27238469	40.20375	-80.772266	0	-0.01	0.35	0.91	4.14
27238470	40.20096	-80.771262	-1.04	-7.2	-0.81	-2.11	5.8
27238471	40.201206	-80.771317	-0.63	-4.36	-0.33	-0.86	3.96
27238472	40.201334	-80.771305	0.39	2.66	0.55	1.43	4.51
27238473	40.203056	-80.771732	1.21	8.34	3.99	10.37	5.45
27238474	40.20318	-80.771755	0.7	4.81	2.05	5.31	4.28
27238475	40.203307	-80.771753	0.48	3.34	0.92	2.38	5.36
27238476	40.200964	-80.771229	-0.23	-1.61	-0.71	-1.85	4.51
27238477	40.201079	-80.77132	0.27	1.89	-0.88	-2.29	3.96
27238478	40.201202	-80.771352	-0.06	-0.41	-0.25	-0.65	3.21
27238479	40.201334	-80.771308	-0.21	-1.44	-0.72	-1.87	3.39
27238480	40.201455	-80.771356	0.72	4.98	0.73	1.9	5.04
27238481	40.201931	-80.771609	-0.25	-1.74	-0.2	-0.51	4.55
27238482	40.202048	-80.771684	-0.34	-2.33	-0.01	-0.02	4.06
27238483	40.203181	-80.77175	-0.53	-3.66	-0.43	-1.12	4.68
27238484	40.203307	-80.77175	-0.62	-4.24	-0.69	-1.8	4.42
27238485	40.201629	-80.770975	0.66	4.52	1.27	3.29	3.35
27238486	40.201757	-80.770971	0.18	1.25	-0.97	-2.5	4.05
27238487	40.202138	-80.770964	1.11	7.64	2.32	6.01	5.91
27238488	40.203101	-80.771376	0.21	1.42	-1.98	-5.15	3.92
27238489	40.20323	-80.771355	0.32	2.22	-0.04	-0.11	2.7
27238490	40.202067	-80.77052	0.15	1.07	0.92	2.38	4.88
27238491	40.20243	-80.770654	-1	-6.87	-0.81	-2.11	5.27
27238492	40.202686	-80.770639	0.74	5.12	1.4	3.64	5.56
27238493	40.203019	-80.771017	-0.03	-0.21	-0.83	-2.16	4.5
27238494	40.203153	-80.770962	1.08	7.44	0.42	1.1	4.04
27238495	40.203415	-80.77089	-0.41	-2.8	-0.85	-2.19	3.87
27238496	40.203536	-80.770939	0.3	2.05	-0.26	-0.67	3.07
27238497	40.204143	-80.771154	-0.95	-6.53	-2.87	-7.45	5.12
27238498	40.204533	-80.771076	-0.71	-4.86	-0.65	-1.69	4.86
27238499	40.204655	-80.771117	-1.49	-10.28	0.24	0.62	5.84
27238500	40.201927	-80.770627	-0.05	-0.34	1.1	2.84	3.59
27238501	40.202064	-80.770539	0.35	2.4	-0.57	-1.48	5.03
27238502	40.202303	-80.770657	0.89	6.16	0.02	0.06	5.52
27238503	40.202422	-80.770724	0.92	6.36	1.07	2.79	5.12
27238504	40.203417	-80.770874	-0.13	-0.88	-0.39	-1.01	4.29
27238505	40.20354	-80.770907	-0.18	-1.21	0.24	0.61	4.68
27238506	40.20267	-80.769756	0.24	1.64	-1.77	-4.59	4.45
27238507	40.202361	-80.769183	-0.39	-2.68	-2.59	-6.71	3.89
27238508	40.202492	-80.769154	0.32	2.17	0.07	0.17	5.3
27238509	40.202609	-80.769231	-1.92	-13.2	-6.17	-16.01	4.89
27238510	40.202736	-80.769233	-1.23	-8.49	-4.69	-12.18	3.89
27238511	40.202862	-80.769231	-0.73	-5.03	-3.81	-9.9	3.5
27238512	40.202981	-80.769295	-0.33	-2.26	-3.84	-9.97	3.44
27238513	40.203234	-80.769302	0.69	4.79	-0.28	-0.72	5.21
27238514	40.203354	-80.769358	0.47	3.21	-0.33	-0.86	5.06
27238515	40.203498	-80.769273	0.91	6.27	1.78	4.63	1.34
27238516	40.203995	-80.769297	-0.5	-3.43	-3.58	-9.29	4.6
27238517	40.204099	-80.769483	0.71	4.93	2.76	7.16	5.02
27238518	40.203039	-80.768832	-0.8	-5.52	-2.96	-7.69	4.01
27238519	40.203166	-80.768836	-0.14	-0.98	-1	-2.59	3.33
27238520	40.203797	-80.768854	-0.46	-3.18	0.09	0.22	4.58
27238521	40.203922	-80.768871	-0.36	-2.45	0.8	2.06	3.4
27238522	40.203202	-80.768547	0.15	1.02	-0.69	-1.78	4.79
27238523	40.203957	-80.768588	0.19	1.34	1.16	3	3.3
27238524	40.204077	-80.768648	0.39	2.66	1.29	3.35	2.39
27238525	40.204201	-80.768667	0.48	3.3	1.24	3.21	3.89
27238526	40.203624	-80.76821	0.42	2.88	-1.19	-3.08	5.21
27238527	40.20331	-80.767684	1.31	9.03	3.79	9.83	5.85
27238528	40.204186	-80.767778	-0.12	-0.79	1.42	3.69	5.27
27238529	40.204439	-80.767783	0.48	3.33	-0.04	-0.12	2.31
27238530	40.204564	-80.767793	1.08	7.45	1.03	2.67	2.9
27238531	40.202912	-80.772885	-0.31	-2.16	-1.23	-3.2	5.08
27238532	40.202779	-80.772932	0.8	5.5	-0.99	-2.57	5.27
27238533	40.202918	-80.772832	0.66	4.52	0.35	0.91	3.47
27238534	40.20197	-80.772304	-0.23	-1.57	-0.35	-0.92	2.69
27238535	40.202097	-80.772307	-0.25	-1.75	-0.35	-0.92	2.19
27238536	40.202225	-80.77229	-0.09	-0.64	1.78	4.62	3.28

27238537	40.202344	-80.772354	0.97	6.71	3.1	8.03	4.42
27238538	40.202471	-80.772355	1.08	7.46	2.39	6.2	4.5
27238539	40.202945	-80.772617	-0.31	-2.11	-1.23	-3.19	5.18
27238540	40.20422	-80.77256	0.45	3.13	-0.45	-1.16	4.77
27238541	40.201974	-80.772275	-0.24	-1.66	1.29	3.33	3.87
27238542	40.202106	-80.772233	-0.35	-2.42	0.4	1.04	3
27238543	40.201664	-80.771715	-0.01	-0.06	-1.77	-4.58	4.73
27238544	40.202419	-80.771753	-0.01	-0.06	2.38	6.19	4.65
27238545	40.202639	-80.772024	-0.18	-1.23	0.18	0.48	5.36
27238546	40.202768	-80.772012	-0.13	-0.91	-1.06	-2.76	2.56
27238547	40.202897	-80.771991	0.16	1.12	-0.53	-1.37	2.41
27238548	40.203035	-80.771902	0.63	4.34	0.29	0.76	4.02
27238549	40.204268	-80.77218	0.62	4.28	3.61	9.36	5.1
27238550	40.204382	-80.77228	0.75	5.15	3.86	10.02	5
27238551	40.201801	-80.771633	-1.85	-12.78	-0.77	-2.01	3.77
27238552	40.201921	-80.771682	-1.76	-12.13	-0.63	-1.64	3.86
27238553	40.202027	-80.771848	-0.45	-3.11	1.95	5.07	5.47
27238554	40.202533	-80.771861	0.07	0.47	1.5	3.88	5.07
27238555	40.202899	-80.771976	-0.15	-1.02	-2.3	-5.98	3.79
27238556	40.203036	-80.771894	0.19	1.33	0.39	1	4.27
27238557	40.200987	-80.771045	-0.6	-4.13	0.97	2.51	3.67
27238558	40.201114	-80.771044	-0.7	-4.8	0.2	0.51	3.68
27238559	40.201234	-80.771097	-0.72	-4.94	1.19	3.08	4.18
27238560	40.20148	-80.771155	0.89	6.16	0.94	2.44	4.77
27238561	40.201611	-80.771122	1.01	6.95	1.48	3.84	3.26
27238562	40.201757	-80.770963	1.08	7.47	2.37	6.15	4.74
27238563	40.203098	-80.771399	0.62	4.31	0.74	1.93	5.48
27238564	40.200997	-80.770962	-0.85	-5.83	1.09	2.83	4.98
27238565	40.201117	-80.771021	-1.49	-10.26	-0.15	-0.38	4.73
27238566	40.201242	-80.771035	-1.45	-10	2.13	5.52	5.49
27238567	40.201605	-80.771172	-0.13	-0.93	0.51	1.32	4.18
27238568	40.201737	-80.771127	0.14	0.96	0.04	0.1	4.16
27238569	40.201861	-80.771148	0.45	3.13	-1.09	-2.84	5.22
27238570	40.202354	-80.771262	0.54	3.75	0.19	0.5	5.49
27238571	40.202492	-80.771171	1.36	9.38	0.95	2.46	5.72
27238572	40.202949	-80.771575	-0.38	-2.6	0.26	0.68	5.18
27238573	40.201581	-80.770351	0.22	1.53	-3	-7.78	5.01
27238574	40.202535	-80.769814	0.74	5.08	2.56	6.66	5.55
27238575	40.202666	-80.769783	0.03	0.24	-1.38	-3.58	4.38
27238576	40.202703	-80.769488	0.65	4.46	0.15	0.39	4.76
27238577	40.202488	-80.769187	0.31	2.15	-1.64	-4.24	3.16
27238578	40.202597	-80.769328	-0.3	-2.05	-4.21	-10.94	4.14
27238579	40.202716	-80.769386	-0.15	-1.03	-3.36	-8.71	4.51
27238580	40.202839	-80.769416	0.27	1.87	-2.29	-5.94	4.61
27238581	40.203488	-80.769349	0.71	4.9	1.62	4.19	1.52
27238582	40.203604	-80.769434	0.04	0.3	-0.58	-1.51	1.7
27238583	40.203718	-80.769484	0.44	3.04	1.23	3.2	3.94
27238584	40.204337	-80.769604	-4.06	-27.99	-4.2	-10.91	9.42
27238585	40.202355	-80.769233	-0.73	-5.02	-2.03	-5.26	4.9
27238586	40.202492	-80.769151	1.06	7.35	0.21	0.54	3.68
27238587	40.202609	-80.769231	-1.3	-8.93	-4.83	-12.54	4
27238588	40.202735	-80.76924	-1.09	-7.54	-4.52	-11.74	3.91
27238589	40.202849	-80.769338	-0.02	-0.14	-3	-7.78	3.49
27238590	40.202981	-80.769297	-0.39	-2.71	-2.87	-7.44	3.96
27238591	40.203226	-80.769369	0.34	2.34	-3.58	-9.29	4.67
27238592	40.20335	-80.769389	0.29	1.98	-2.09	-5.42	4.16
27238593	40.203492	-80.769315	0.85	5.85	1.65	4.27	1.59
27238594	40.203605	-80.769375	0.23	1.58	-1.29	-3.35	3.02
27238595	40.204092	-80.769536	0.92	6.32	2.7	7.01	4.26
27238596	40.204225	-80.769491	1.07	7.4	2.29	5.95	4.61
27238597	40.202634	-80.769036	-0.07	-0.47	-1.61	-4.17	4.15
27238598	40.202771	-80.76895	-0.31	-2.13	-2.05	-5.31	2.54
27238599	40.20291	-80.768852	0.43	2.95	-0.33	-0.85	2.46
27238600	40.203033	-80.76888	2.39	16.46	5.42	14.06	5.94
27238601	40.203172	-80.768785	1.86	12.83	3.14	8.16	5.5
27238602	40.203415	-80.768869	0.27	1.87	-0.39	-1.02	4.93
27238603	40.202639	-80.768994	0.96	6.61	0.56	1.46	4.81
27238604	40.202925	-80.768728	0.74	5.08	2.14	5.56	3.65
27238605	40.203033	-80.768884	-0.13	-0.87	-1.92	-4.99	2.87

27238606	40.203165	-80.76884	0.16	1.09	-1.32	-3.42	2.75
27238607	40.203213	-80.768456	0.37	2.59	0.9	2.34	4.94
27238608	40.203338	-80.768469	0.19	1.31	0.05	0.14	3.8
27238609	40.20347	-80.768426	0.08	0.58	1.28	3.32	4.6
27238610	40.203597	-80.76843	1.03	7.14	2.1	5.46	5.47
27238611	40.20396	-80.768568	0.45	3.08	0.44	1.13	4.01
27238612	40.204086	-80.768574	0.21	1.43	1.41	3.66	2.64
27238613	40.204205	-80.768636	0.3	2.09	1.65	4.27	3.57
27238614	40.203214	-80.768454	0.61	4.19	0.45	1.16	4.37
27238615	40.203343	-80.768429	0.5	3.43	1.31	3.4	4.03
27238616	40.203464	-80.76848	1.05	7.21	2.87	7.45	5.02
27238617	40.203593	-80.768463	0.66	4.54	2.48	6.43	3.18
27238618	40.203725	-80.768421	0.33	2.29	0.43	1.11	3.14
27238619	40.203957	-80.768591	0.61	4.2	-0.56	-1.45	5.32
27238620	40.204097	-80.768488	-0.04	-0.25	-0.31	-0.82	4.98
27238621	40.204442	-80.767756	0.83	5.73	0.69	1.79	2.84
27238622	40.203218	-80.773474	-0.51	-3.51	-1.91	-4.97	2.65
27238623	40.203344	-80.773479	-0.18	-1.22	-2.14	-5.56	2.8
27238624	40.203472	-80.773471	-0.48	-3.32	-0.45	-1.16	4.14
27238625	40.203722	-80.773499	-0.23	-1.55	-0.77	-1.99	3.28
27238626	40.203851	-80.773482	-0.1	-0.67	-2.41	-6.26	4.62
27238627	40.203223	-80.773434	-0.31	-2.1	-0.76	-1.98	3.13
27238628	40.203355	-80.77339	-0.21	-1.45	-0.06	-0.15	2.63
27238629	40.20349	-80.773326	0.06	0.42	0.42	1.09	4.24
27238630	40.203728	-80.773453	-0.21	-1.48	-2.92	-7.57	4.79
27238631	40.203843	-80.773546	0.21	1.43	-1.49	-3.87	4.9
27238632	40.203605	-80.773418	0.15	1.01	-2.43	-6.31	4.91
27238633	40.203732	-80.773417	0.01	0.07	-0.86	-2.23	5.33
27238634	40.204239	-80.772406	1.06	7.32	1.43	3.72	4.98
27238635	40.200974	-80.77115	-0.55	-3.81	-1.63	-4.23	5.2
27238636	40.201101	-80.771146	-0.06	-0.41	0.17	0.44	3.29
27238637	40.201223	-80.771182	0.36	2.48	2.26	5.87	4.62
27238638	40.201469	-80.771243	0.64	4.43	2.73	7.07	4.42
27238639	40.201595	-80.771254	0.72	4.96	3.24	8.41	4.06
27238640	40.201849	-80.771251	0.61	4.21	0.31	0.81	4.59
27238641	40.202835	-80.77147	-1.74	-12.01	-2.78	-7.2	6.2
27238642	40.202165	-80.770746	0.9	6.22	0	0	4.98
27238643	40.20338	-80.771174	-0.11	-0.74	-0.06	-0.15	4.99
27238644	40.201796	-80.770661	0.82	5.66	-0.25	-0.64	5.33
27238645	40.202046	-80.770688	0.89	6.15	0.47	1.21	5.01
27238646	40.20218	-80.770624	1.46	10.06	0.62	1.61	5.51
27238647	40.203398	-80.771029	-0.19	-1.29	-0.04	-0.1	4.87
27238648	40.2019	-80.76983	-1.54	-10.6	-2.29	-5.94	5.7
27238649	40.202535	-80.769823	0.4	2.76	-2.53	-6.56	5.23
27238650	40.20267	-80.769754	0.99	6.86	0.78	2.04	5.23
27238651	40.202583	-80.769436	0.25	1.73	-2.48	-6.43	4.58
27238652	40.202708	-80.76945	0.18	1.23	-1.66	-4.31	4.83
27238653	40.202587	-80.769401	0.26	1.81	-0.05	-0.12	4.77
27238654	40.202708	-80.769449	0.1	0.67	-2.68	-6.96	4.54
27238655	40.203204	-80.769544	2.25	15.53	7.08	18.36	6.96
27238656	40.20261	-80.769224	-0.33	-2.29	-1.99	-5.17	5.24
27238657	40.202741	-80.769193	0.07	0.49	-3.42	-8.87	4.03
27238658	40.202874	-80.769141	0.15	1.04	-2.19	-5.67	3.84
27238659	40.203	-80.769149	-0.5	-3.44	-2.69	-6.97	4.01
27238660	40.204243	-80.769346	0.28	1.96	1.22	3.16	5.05
27238661	40.202517	-80.768949	0.03	0.2	0.23	0.59	4.89
27238662	40.20262	-80.769146	-0.08	-0.56	-2.18	-5.65	3.16
27238663	40.202738	-80.769211	-0.93	-6.43	-3.89	-10.1	3.53
27238664	40.203001	-80.769137	0.51	3.55	-0.87	-2.27	4.44
27238665	40.202942	-80.768593	0.26	1.78	-0.78	-2.03	4.59
27238666	40.203084	-80.768473	0.21	1.43	-0.4	-1.04	3.95
27238667	40.203173	-80.768779	0.95	6.53	-1.13	-2.94	4.7
27238668	40.20345	-80.767581	2.02	13.9	3.09	8.02	6.7
27238669	40.204447	-80.767714	0.74	5.13	1.18	3.05	3.74
27238670	40.204571	-80.767739	1.15	7.97	3.11	8.07	5.43
27238671	40.203461	-80.767494	1.45	9.98	1.7	4.42	6.39
27238672	40.204444	-80.767739	-0.94	-6.47	0.48	1.24	4.41
27238673	40.203809	-80.773817	-0.18	-1.23	-0.64	-1.65	3.11
27238674	40.203812	-80.773793	-0.2	-1.37	-0.07	-0.19	2.4

27238675	40.203356	-80.773386	0.37	2.52	-0.2	-0.51	2.74
27238676	40.203486	-80.77336	0.82	5.67	-0.45	-1.16	4.76
27238677	40.202442	-80.772586	-0.48	-3.3	-1.56	-4.06	4.41
27238678	40.202568	-80.772589	-0.91	-6.25	-2.3	-5.97	4.52
27238679	40.2027	-80.772554	-0.93	-6.39	-2.05	-5.33	4.92
27238680	40.202826	-80.772554	-0.38	-2.6	-0.99	-2.58	4.63
27238681	40.202944	-80.772623	0.39	2.71	-0.78	-2.03	3.18
27238682	40.20331	-80.772741	-0.79	-5.43	-0.89	-2.3	5.46
27238683	40.203436	-80.772747	-1.77	-12.2	-1.55	-4.02	5.92
27238684	40.203569	-80.772695	-2.52	-17.38	0.31	0.81	6.99
27238685	40.203695	-80.772706	0.01	0.06	1.62	4.19	4.6
27238686	40.204187	-80.772821	0.33	2.31	0.6	1.55	5.01
27238687	40.20432	-80.772778	0.46	3.18	1.32	3.41	4.68
27238688	40.201765	-80.771916	0.42	2.92	0.78	2.04	2.93
27238689	40.201888	-80.771946	0.83	5.73	0.62	1.61	4.25
27238690	40.202384	-80.772037	0.37	2.55	0.8	2.07	5.04
27238691	40.202494	-80.772167	0.25	1.75	-1.26	-3.27	5.09
27238692	40.204246	-80.772351	0.31	2.16	1.23	3.18	4.93
27238693	40.201061	-80.771465	-0.36	-2.5	-0.29	-0.74	4.12
27238694	40.201197	-80.771391	-0.26	-1.79	-1.3	-3.38	3.92
27238695	40.201675	-80.771621	-0.34	-2.37	-2.15	-5.57	5.07
27238696	40.201804	-80.771606	-0.95	-6.53	-1.66	-4.3	5.28
27238697	40.202663	-80.771838	-0.29	-1.99	-1.35	-3.5	3.4
27238698	40.202795	-80.771796	-0.16	-1.14	0.75	1.94	4.17
27238699	40.202914	-80.771855	0.97	6.66	0.63	1.62	3.09
27238700	40.203034	-80.77191	1.15	7.95	0.77	2	4.98
27238701	40.20096	-80.771259	0.19	1.28	0.39	1.01	3.7
27238702	40.201071	-80.771385	1.09	7.51	0.74	1.92	4.85
27238703	40.202793	-80.771809	1.68	11.56	1.91	4.96	5.46
27238704	40.202914	-80.771858	1.53	10.56	0.06	0.16	4.38
27238705	40.203043	-80.771841	1.04	7.2	-3.07	-7.96	5.03
27238706	40.20125	-80.770969	-0.26	-1.8	2.19	5.68	4.79
27238707	40.201744	-80.771073	-0.62	-4.25	-0.17	-0.45	3.41
27238708	40.201866	-80.771112	-0.06	-0.42	0.96	2.48	3.48
27238709	40.202106	-80.771222	1.2	8.26	-0.45	-1.17	4.61
27238710	40.202962	-80.771469	0.2	1.38	0.62	1.61	4.25
27238711	40.203098	-80.771398	0.2	1.37	0.21	0.54	2.13
27238712	40.203223	-80.77141	0.25	1.69	0.22	0.57	2.58
27238713	40.20162	-80.771051	1.2	8.25	3.33	8.63	5.18
27238714	40.201754	-80.770994	0.05	0.37	-1.37	-3.56	2.81
27238715	40.201871	-80.771074	0.51	3.54	2.27	5.88	4.35
27238716	40.201987	-80.771154	0.14	0.98	0.08	0.21	5.08
27238717	40.202112	-80.771171	0.05	0.33	-0.74	-1.93	4.16
27238718	40.203098	-80.771399	0.35	2.41	-0.19	-0.49	2.32
27238719	40.203223	-80.771409	-0.2	-1.35	-1.28	-3.31	2.23
27238720	40.203336	-80.77152	0.25	1.75	-0.89	-2.31	4.66
27238721	40.204539	-80.771026	-0.13	-0.89	0.57	1.48	3.08
27238722	40.204664	-80.77104	-0.41	-2.81	0.12	0.31	3.18
27238723	40.204543	-80.770994	0.04	0.29	0.5	1.31	3.92
27238724	40.204671	-80.770988	0.01	0.07	0.32	0.82	3.6
27238725	40.201577	-80.77038	0.72	4.95	0.35	0.9	4.45
27238726	40.201692	-80.770478	0.1	0.68	0.36	0.93	2.7
27238727	40.201815	-80.770503	0.05	0.34	0.07	0.19	1.69
27238728	40.201939	-80.770529	0.11	0.77	0.43	1.13	2.48
27238729	40.20231	-80.7706	-0.84	-5.79	-2.06	-5.35	5.47
27238730	40.20269	-80.76959	0.41	2.83	-0.27	-0.7	4.93
27238731	40.202522	-80.768916	0.04	0.29	1.51	3.91	5.14
27238732	40.203535	-80.768918	-0.26	-1.76	0.3	0.79	3.99
27238733	40.203647	-80.769044	2	13.79	1.63	4.23	6.39
27238734	40.20282	-80.768561	0.42	2.88	0.91	2.36	5.12
27238735	40.203589	-80.768495	0.83	5.74	2.37	6.14	4.25
27238736	40.203719	-80.768467	0.25	1.76	0.02	0.05	3.08
27238737	40.203851	-80.768424	-0.16	-1.1	0.76	1.99	5.19
27238738	40.204272	-80.768099	1.22	8.39	1.02	2.64	4.87
27238739	40.204402	-80.768075	1.1	7.58	0.76	1.97	4.33
27238740	40.203887	-80.768138	1.52	10.52	1.57	4.09	5.85
27238741	40.204275	-80.768075	1.22	8.41	2.13	5.53	4.54
27238742	40.2044	-80.76809	1.42	9.78	1.43	3.71	4.51
27238743	40.204434	-80.767818	-0.02	-0.15	-1.41	-3.65	5.42

27238744	40.203344	-80.773477	0.27	1.85	0.08	0.2	3.42
27238745	40.203472	-80.773474	0.06	0.42	-0.54	-1.41	4.31
27238746	40.203713	-80.773569	0.06	0.44	-1.52	-3.94	4.5
27238747	40.203388	-80.773133	-0.13	-0.89	-1.35	-3.49	3.86
27238748	40.203508	-80.773184	0.07	0.49	-1.04	-2.69	4.32
27238749	40.202767	-80.773026	0.41	2.86	0.27	0.71	4.53
27238750	40.202907	-80.77292	0	-0.02	0.19	0.5	3.44
27238751	40.203383	-80.773174	-0.49	-3.41	-1.4	-3.62	3.74
27238752	40.203514	-80.773133	-0.39	-2.66	-1.01	-2.63	3.77
27238753	40.201868	-80.772104	0.01	0.06	1.72	4.46	4.62
27238754	40.201983	-80.772198	-0.22	-1.55	-1.58	-4.1	5.06
27238755	40.202114	-80.772169	-0.64	-4.42	0.03	0.07	4.55
27238756	40.20223	-80.772256	-0.85	-5.86	-0.12	-0.31	4.6
27238757	40.202354	-80.77228	-1.41	-9.73	-3.39	-8.8	5.71
27238758	40.201874	-80.772058	-0.1	-0.71	2.08	5.4	4.95
27238759	40.20198	-80.772223	-0.96	-6.6	-1.31	-3.39	5.38
27238760	40.202116	-80.772151	-1.32	-9.1	-2.27	-5.88	5.95
27238761	40.202221	-80.772323	-0.92	-6.37	-0.53	-1.38	5.21
27238762	40.202985	-80.772299	-0.33	-2.27	-0.32	-0.84	5.29
27238763	40.201069	-80.771399	-0.16	-1.11	0.7	1.81	4.64
27238764	40.201186	-80.771481	-0.07	-0.51	-0.02	-0.04	4.48
27238765	40.201672	-80.771648	-0.22	-1.51	-2.69	-6.99	4.55
27238766	40.201805	-80.7716	-1.76	-12.13	-1.35	-3.49	3.94
27238767	40.201932	-80.771597	-1.91	-13.14	-0.66	-1.72	4.8
27238768	40.202654	-80.771908	-0.17	-1.2	-1.21	-3.14	5.09
27238769	40.202787	-80.771857	-2.11	-14.53	1.53	3.98	4.48
27238770	40.202912	-80.771869	1.18	8.18	2.95	7.64	3.82
27238771	40.20316	-80.771918	-0.28	-1.96	-1.2	-3.11	5.12
27238772	40.201633	-80.770949	0.45	3.12	1.01	2.63	4.64
27238773	40.201992	-80.771123	0.5	3.44	-0.94	-2.45	3.39
27238774	40.202125	-80.771067	0.58	4	0.27	0.71	2.49
27238775	40.202259	-80.77101	0.87	6.03	2.43	6.3	3.83
27238776	40.202623	-80.771142	-2.67	-18.42	-10.74	-27.88	7.03
27238777	40.202973	-80.771389	-0.7	-4.85	-0.49	-1.27	5.27
27238778	40.203366	-80.771284	0.42	2.89	-0.2	-0.53	4.85
27238779	40.202001	-80.771049	0.21	1.47	-1.41	-3.66	5
27238780	40.20214	-80.770951	0.57	3.93	-0.83	-2.15	4.34
27238781	40.202266	-80.770951	0.44	3.04	2.12	5.49	4.56
27238782	40.202504	-80.771083	0.27	1.9	1.31	3.41	3.88
27238783	40.202635	-80.771048	0.41	2.82	2.88	7.48	2.78
27238784	40.202749	-80.771151	0.15	1.02	0.07	0.17	4.16
27238785	40.202869	-80.771206	-1.07	-7.37	-1.24	-3.22	4.48
27238786	40.202991	-80.771241	-2.19	-15.09	-0.48	-1.25	5.75
27238787	40.203243	-80.771253	0.82	5.67	-1.18	-3.07	5.34
27238788	40.203362	-80.771313	0.66	4.53	0.93	2.4	4.63
27238789	40.203975	-80.771479	-5.06	-34.93	-7.71	-20	11.54
27238790	40.204113	-80.771395	-5.32	-36.7	-8.03	-20.84	11.92
27238791	40.20424	-80.771389	-6.87	-47.32	-8.4	-21.8	22.04
27238792	40.201449	-80.770393	0.72	4.96	-0.44	-1.13	4.43
27238793	40.201574	-80.770411	0.25	1.74	-1.21	-3.13	3.76
27238794	40.201696	-80.770447	-0.55	-3.83	-1.37	-3.57	3.5
27238795	40.201825	-80.770428	0.11	0.75	-0.28	-0.73	1.74
27238796	40.201958	-80.770377	0.3	2.07	1.44	3.73	2.71
27238797	40.20122	-80.770196	-0.67	-4.65	-1.13	-2.92	5.54
27238798	40.20134	-80.770247	-1.01	-6.99	-1.96	-5.08	4.72
27238799	40.201452	-80.770369	0.59	4.1	-1.07	-2.77	4.08
27238800	40.201578	-80.770376	-0.54	-3.72	-1.88	-4.87	2.88
27238801	40.201698	-80.770427	0.48	3.31	-1.51	-3.91	4.1
27238802	40.202598	-80.769317	-0.03	-0.21	-2.81	-7.28	3.17
27238803	40.202725	-80.769314	-0.52	-3.56	-3.43	-8.9	3.59
27238804	40.202839	-80.76942	-0.2	-1.36	-3.04	-7.88	4.08
27238805	40.2026	-80.769299	-0.38	-2.66	-2.15	-5.57	3.55
27238806	40.202722	-80.769341	-0.09	-0.59	-1.63	-4.22	3
27238807	40.202849	-80.769342	0.44	3.01	-0.87	-2.26	3.09
27238808	40.203208	-80.769508	0.57	3.94	-0.66	-1.71	5.09
27238809	40.204201	-80.769683	-12.4	-85.55	-10.6	-27.52	25.54
27238810	40.204327	-80.769682	-6.41	-44.19	-11.28	-29.28	15.26
27238811	40.202402	-80.768861	-0.3	-2.08	1.81	4.7	4.75
27238812	40.202526	-80.768884	-0.46	-3.14	0.39	1.01	4.8

27238813	40.202625	-80.769102	0.46	3.16	-1.08	-2.79	4.73
27238814	40.202739	-80.769204	-2.08	-14.31	-7.33	-19.03	5.64
27238815	40.20289	-80.769009	1.33	9.17	2.16	5.6	4.12
27238816	40.203028	-80.768917	2.03	14.03	4.07	10.56	6.33
27238817	40.203378	-80.769163	0.38	2.63	-2.98	-7.74	5.18
27238818	40.203515	-80.769079	0.02	0.14	-2.64	-6.86	4.6
27238819	40.202643	-80.768965	1.35	9.3	1.68	4.37	6.17
27238820	40.202766	-80.768993	0.44	3.02	-3.48	-9.02	4.63
27238821	40.202906	-80.768889	0.02	0.12	-0.87	-2.25	3.79
27238822	40.203055	-80.76871	0.35	2.42	-1.46	-3.78	3.15
27238823	40.203169	-80.768805	0.48	3.34	-1.21	-3.13	2.91
27238824	40.203288	-80.768869	0.64	4.42	0.42	1.08	5.49
27238825	40.203793	-80.768889	-0.16	-1.08	-0.76	-1.98	3.2
27238826	40.203919	-80.768892	-0.14	-0.98	-0.66	-1.71	2.58
27238827	40.204045	-80.768904	-0.12	-0.83	-0.13	-0.34	3.29
27238828	40.20305	-80.76875	0.89	6.12	-1.73	-4.48	4.52
27238829	40.203172	-80.768783	1.04	7.19	-1.12	-2.9	3.64
27238830	40.203304	-80.768744	1.48	10.21	-0.84	-2.18	5.7
27238831	40.203524	-80.769009	0.33	2.27	1.41	3.66	4.85
27238832	40.203793	-80.768889	0.45	3.11	-1.41	-3.65	4.12
27238833	40.20392	-80.768889	0.14	0.97	-1.67	-4.33	3.39
27238834	40.203094	-80.768397	-1.06	-7.34	-1.7	-4.42	5.84
27238835	40.203584	-80.768533	1.89	13.01	1.14	2.96	6.34
27238836	40.203723	-80.768432	0.76	5.21	-0.41	-1.07	4.44
27238837	40.203859	-80.768358	0.1	0.72	0.42	1.09	4.7
27238838	40.203311	-80.767674	2.93	20.24	3.82	9.92	7.38
27238839	40.20466	-80.76804	0.82	5.63	1.51	3.91	5.35
27238840	40.20423	-80.767421	0.87	6.02	-0.26	-0.67	3.86
27238841	40.203953	-80.769635	-6.54	-45.07	-12.7	-32.96	11.78
27238842	40.202746	-80.771168	-2.29	-15.78	-8.31	-21.58	6.44
27238843	40.202237	-80.769162	-2.11	-14.53	-6.65	-17.27	6.51
27238844	40.201495	-80.771035	-3.53	-24.33	2.05	5.33	11.5
27238845	40.203192	-80.770652	-12.21	-84.14	-20.33	-52.76	30.48
27238846	40.203316	-80.77067	-12.05	-83	-19.63	-50.95	26.13
27238847	40.2032	-80.770581	-12.84	-88.45	-20.08	-52.1	28.88
27238848	40.201496	-80.771029	-3.64	-25.11	2.53	6.57	10.27
27238849	40.204563	-80.767802	0.81	5.6	0	-0.01	3.34
27238850	40.202856	-80.769281	-1.81	-12.45	-6.54	-16.98	6.56
27238851	40.204333	-80.76964	-6.9	-47.52	-15.85	-41.14	15.76
27238852	40.203579	-80.769632	0.85	5.84	0.62	1.6	1.84
27238853	40.203584	-80.769591	0.81	5.61	0.18	0.46	1.74
27238854	40.203516	-80.769127	0.58	3.99	1.15	2.99	2.05
27238855	40.203639	-80.769152	0.92	6.35	1.94	5.03	1.89
27238856	40.203646	-80.769103	0.82	5.67	1.78	4.62	1.78
27238857	40.203571	-80.769699	0.92	6.32	-0.78	-2.02	2.68
27238858	40.203417	-80.769918	0.56	3.88	-1.52	-3.93	3.3
27238859	40.203475	-80.76945	0.83	5.75	1.04	2.69	2.01
27238860	40.2036	-80.769465	0.94	6.51	1.69	4.37	1.76
27238861	40.203473	-80.769472	0.55	3.77	0.96	2.49	2.6
27238862	40.203603	-80.769443	0.82	5.66	1.47	3.82	1.43
27238863	40.203319	-80.769686	0.69	4.77	0.12	0.32	3.99
27238864	40.203309	-80.769767	0.74	5.11	0.4	1.03	3.12
27238865	40.203422	-80.769877	0.73	5	1.14	2.96	3.28
27238866	40.203472	-80.769478	0.92	6.38	-0.67	-1.75	2.27
27238868	40.203424	-80.769855	0.63	4.38	0.17	0.44	2.44
27238869	40.203306	-80.76979	0.42	2.93	0.14	0.37	3.39
27238870	40.203425	-80.769853	0.53	3.67	-1.2	-3.11	3.34
27238871	40.203468	-80.769511	0.93	6.38	0.86	2.22	2.3
27238873	40.203508	-80.769191	0.94	6.5	1.9	4.93	1.89
27238874	40.203633	-80.769202	0.91	6.28	1.96	5.08	1.72
27238875	40.20351	-80.769176	0.88	6.04	1.45	3.77	1.39
27238876	40.20333	-80.769597	0.92	6.34	-0.46	-1.2	3.54
27238877	40.203576	-80.769661	1.03	7.08	0.39	1.01	3.24
27238878	40.203319	-80.769681	0.95	6.53	1.2	3.12	3.94
27238879	40.203563	-80.769762	1.11	7.63	1.43	3.72	3.43
27238880	40.203567	-80.769726	0.69	4.77	-1.59	-4.13	2.64
27238881	40.18326	-80.799122	-0.66	-4.55	-0.5	-1.29	4.67
27238882	40.183381	-80.799171	-2.17	-14.98	-3.03	-7.86	4.84
27238883	40.183383	-80.799156	-0.39	-2.7	0.42	1.09	5.3

27238884	40.188262	-80.792623	-0.85	-5.84	-1.55	-4.01	3.37
27238885	40.18838	-80.792692	-0.76	-5.24	-1.86	-4.83	4.99
27238886	40.187938	-80.792173	0.57	3.95	-0.98	-2.55	5.52
27238887	40.187951	-80.792073	-0.44	-3.01	-0.68	-1.76	5.59
27238888	40.187815	-80.792148	-0.25	-1.71	1.12	2.9	2.39
27238889	40.187928	-80.792256	0	0	-0.05	-0.13	0.78
27238890	40.188052	-80.792278	0.28	1.92	0.3	0.77	1.21
27238891	40.18766	-80.790348	0.13	0.87	0.38	0.99	4.17
27238892	40.187453	-80.789975	-0.03	-0.19	0.05	0.13	3.45
27238893	40.187572	-80.790041	0.01	0.04	0.29	0.76	2.7
27238894	40.18768	-80.79019	-0.28	-1.93	-0.69	-1.78	2.35
27238895	40.187819	-80.790093	-0.17	-1.2	0.27	0.7	2.72
27238896	40.18808	-80.790033	0.17	1.2	-0.5	-1.31	4.84
27238897	40.187463	-80.7899	-0.25	-1.74	-0.19	-0.51	4.48
27238898	40.187567	-80.79008	-0.07	-0.46	-0.93	-2.42	1.91
27238899	40.18769	-80.790108	0.04	0.29	-0.99	-2.57	1.62
27238900	40.187814	-80.790132	0.2	1.36	-0.66	-1.71	1.72
27238902	40.187465	-80.789885	-0.34	-2.37	-1.39	-3.59	5.02
27238903	40.18757	-80.790061	-0.27	-1.86	-1.16	-3.02	1.75
27238904	40.187694	-80.790084	0.07	0.48	-0.98	-2.54	1.51
27238905	40.187818	-80.7901	0.3	2.08	-0.7	-1.82	1.83
27238906	40.189115	-80.788858	0.53	3.68	-0.16	-0.41	5.3
27238907	40.189239	-80.788884	0.68	4.71	-0.07	-0.19	3.38
27238908	40.189264	-80.788686	-0.07	-0.5	-0.59	-1.52	2.87
27238909	40.189383	-80.788748	-0.07	-0.5	-0.84	-2.18	2.41
27238910	40.189503	-80.788801	-0.34	-2.34	-0.54	-1.41	4.47
27238911	40.189251	-80.788787	0.23	1.56	0.12	0.32	3.05
27238912	40.189362	-80.788915	0.14	0.95	-0.42	-1.1	2.55
27238913	40.189501	-80.788816	0.52	3.59	0.97	2.52	3.2
27238914	40.19015	-80.787691	0.2	1.41	0.06	0.15	5.25
27238915	40.190284	-80.787627	0.3	2.08	0	0.01	2.7
27238916	40.190414	-80.787605	0.35	2.44	0.19	0.49	2.97
27238917	40.190286	-80.787615	1.25	8.6	2.31	5.98	5.09
27238918	40.190413	-80.787615	1.3	8.98	1.83	4.74	5.61
27238919	40.190278	-80.787675	1.69	11.68	1.45	3.78	6.17
27238920	40.190398	-80.78773	1.66	11.46	1.18	3.07	5.43
27238921	40.190592	-80.787192	0.95	6.55	1.31	3.39	4.8
27238922	40.190714	-80.787236	0.79	5.47	0.85	2.2	3.59
27238923	40.190838	-80.787256	0.6	4.15	0.28	0.72	3.38
27238924	40.190711	-80.787256	0.66	4.56	0.94	2.43	5.46
27238925	40.190844	-80.787211	0.42	2.87	-0.3	-0.78	3.68
27238926	40.183012	-80.799078	-0.49	-3.41	-2.84	-7.37	5.11
27238927	40.188031	-80.792445	0	0.02	0.46	1.19	4.38
27238928	40.18816	-80.792429	0.36	2.45	0.76	1.97	4.09
27238929	40.187924	-80.792289	0.48	3.34	0.7	1.82	5.02
27238930	40.187629	-80.790598	-0.22	-1.49	-1.28	-3.32	3.18
27238931	40.187756	-80.790593	-0.12	-0.85	-0.63	-1.64	2.5
27238932	40.187876	-80.790646	-0.21	-1.45	-1.31	-3.4	3.89
27238933	40.18765	-80.790428	-0.87	-6.01	-1.05	-2.73	4.7
27238934	40.187773	-80.790457	-0.02	-0.13	-0.24	-0.63	4.87
27238935	40.187586	-80.789932	-1.61	-11.11	-0.99	-2.56	4.89
27238936	40.187717	-80.789891	-0.38	-2.64	-0.05	-0.12	2.47
27238937	40.187843	-80.789898	-0.08	-0.58	0.17	0.44	2.48
27238938	40.188084	-80.79	0.73	5.04	1.21	3.15	4.59
27238939	40.187714	-80.789917	-0.26	-1.79	0.67	1.74	2.75
27238940	40.187843	-80.7899	-0.24	-1.63	0.57	1.49	3.28
27238941	40.188087	-80.789976	0.15	1.06	0.07	0.18	2.35
27238942	40.188211	-80.789998	0.2	1.41	-0.76	-1.97	4.8
27238943	40.188089	-80.78996	-0.66	-4.56	-1.02	-2.66	4.62
27238944	40.189557	-80.788372	0.04	0.26	-0.21	-0.54	5.14
27238945	40.189687	-80.788342	-0.98	-6.75	-1.32	-3.44	5.96
27238946	40.189759	-80.786765	0.38	2.64	-0.44	-1.13	4.92
27238947	40.190746	-80.786976	0.63	4.32	0.21	0.56	5.14
27238948	40.189641	-80.78669	0.43	2.96	-0.22	-0.57	5.09
27238949	40.189769	-80.786683	0.55	3.77	-0.52	-1.35	4.26
27238950	40.188075	-80.791086	-0.12	-0.82	-0.85	-2.21	5.27
27238951	40.188202	-80.791084	-1.05	-7.24	-0.76	-1.97	4.91
27238952	40.188085	-80.791003	-0.09	-0.63	-0.83	-2.14	5.17
27238953	40.188207	-80.791041	-0.23	-1.59	-0.58	-1.49	3.56

27238954	40.188336	-80.791025	-0.42	-2.9	-0.1	-0.25	4.58
27238955	40.189527	-80.788611	1.18	8.12	0.57	1.48	5.15
27238956	40.189659	-80.788566	1.09	7.55	1.38	3.59	4.75
27238957	40.190452	-80.787299	0.99	6.85	0.76	1.96	5.38
27238958	40.190323	-80.787317	0.57	3.94	-1.37	-3.55	5.24
27238959	40.190443	-80.787375	0.98	6.77	0.84	2.19	4.76
27238960	40.190569	-80.787377	1.37	9.46	1.02	2.64	5.78
27238961	40.190691	-80.787419	-0.52	-3.57	-0.11	-0.28	5.11
27238962	40.187546	-80.790246	-0.49	-3.4	-0.05	-0.13	4.75
27238963	40.18767	-80.790267	-0.2	-1.39	0.45	1.17	3.11
27238964	40.187801	-80.790238	0.14	0.96	0.47	1.23	4.64
27238965	40.187556	-80.790167	-0.42	-2.91	-1.23	-3.2	5
27238966	40.18769	-80.790112	-0.69	-4.73	0.05	0.13	5.08
27238967	40.189382	-80.788757	1.09	7.54	-0.22	-0.57	5.49
27238968	40.189515	-80.788706	1.34	9.24	-0.53	-1.38	5.03
27238969	40.1905	-80.78793	1.24	8.55	1.19	3.09	5.34
27238970	40.190513	-80.787827	0.93	6.38	0.09	0.23	4.26
27238971	40.190638	-80.787838	0.66	4.54	0.05	0.13	5.06
27238972	40.190483	-80.787055	0.75	5.19	-0.23	-0.59	5.13
27238973	40.190599	-80.787137	0.46	3.19	0.32	0.84	3.52
27238974	40.184415	-80.799014	-1.92	-13.24	-0.76	-1.98	6.36
27238975	40.187804	-80.792234	-0.36	-2.49	-0.26	-0.69	2.1
27238976	40.187931	-80.792233	-0.25	-1.75	-0.28	-0.72	1.12
27238977	40.188055	-80.79225	-0.04	-0.31	-0.32	-0.84	1.37
27238978	40.18781	-80.792182	-1.75	-12.07	-0.96	-2.5	4.51
27238979	40.187948	-80.792091	-1.33	-9.17	-0.23	-0.6	3.8
27238980	40.188077	-80.792078	-0.88	-6.05	-0.17	-0.45	3.52
27238981	40.187947	-80.792107	0.42	2.87	0.05	0.12	4.01
27238982	40.188074	-80.792098	0.44	3.02	0.21	0.55	3.44
27238983	40.187844	-80.791909	-1.33	-9.19	-1.49	-3.86	5.84
27238984	40.187961	-80.791989	-1.39	-9.58	-0.18	-0.45	4.15
27238985	40.1881	-80.791892	-1.78	-12.28	-1.17	-3.04	5.77
27238986	40.188216	-80.79097	0.69	4.78	2.92	7.57	4.69
27238987	40.188341	-80.790987	0.24	1.67	1.39	3.6	4.17
27238988	40.187969	-80.790918	0.39	2.68	-0.63	-1.65	4.58
27238989	40.188092	-80.790951	1.58	10.87	3.17	8.22	5.38
27238990	40.188218	-80.790955	0.54	3.73	2.06	5.36	3.01
27238991	40.188326	-80.791103	-0.53	-3.67	-0.49	-1.26	2.24
27238992	40.188468	-80.790979	-0.15	-1.06	-0.35	-0.91	2.18
27238993	40.187965	-80.790953	0.37	2.54	-1.08	-2.81	5.22
27238994	40.188219	-80.790948	0.13	0.87	-0.69	-1.78	3.34
27238995	40.188329	-80.791083	-0.15	-1.01	-1.29	-3.35	2.22
27238996	40.188468	-80.790985	0.2	1.36	0.1	0.27	2.92
27238997	40.189422	-80.788437	0.42	2.92	-0.96	-2.5	4.79
27238998	40.189547	-80.788449	0.29	2.01	-1.01	-2.61	3.03
27238999	40.189907	-80.788615	1.2	8.29	0.13	0.35	5.9
27239000	40.189562	-80.788331	-0.05	-0.34	0.75	1.95	3.55
27239001	40.189551	-80.788421	0.34	2.35	1.1	2.84	3.22
27239002	40.189687	-80.788345	-0.34	-2.33	-0.12	-0.31	4.81
27239003	40.189931	-80.788419	0.56	3.86	-1.15	-3	5.08
27239004	40.190287	-80.787604	0.06	0.45	-0.06	-0.16	4.36
27239005	40.190155	-80.787645	0.17	1.16	-0.22	-0.57	3.99
27239006	40.190279	-80.787669	0.16	1.08	0.15	0.4	2.28
27239007	40.190407	-80.787656	0.4	2.76	0.69	1.78	2.88
27239008	40.190573	-80.787349	-0.03	-0.19	-1.21	-3.13	4.46
27239009	40.190589	-80.787222	0.72	4.95	1.67	4.33	4.41
27239010	40.190716	-80.787221	0.38	2.62	0.64	1.66	3.96
27239011	40.190841	-80.787235	0.18	1.22	0.17	0.45	4.88
27239012	40.189806	-80.78639	1.05	7.24	0.04	0.1	5.74
27239013	40.182856	-80.799313	0.59	4.06	2.09	5.43	5.41
27239014	40.182866	-80.799227	0.51	3.49	0.33	0.85	4.81
27239015	40.184823	-80.798795	1.8	12.41	1.63	4.22	6.35
27239016	40.188394	-80.792585	-0.01	-0.08	-0.74	-1.92	3.36
27239017	40.188273	-80.792532	0.36	2.49	0.15	0.38	2.62
27239018	40.188392	-80.792597	0.34	2.34	-0.97	-2.52	3.14
27239019	40.188152	-80.79249	-0.14	-0.95	-2.56	-6.63	3.41
27239020	40.188286	-80.792433	0.15	1.02	-1.2	-3.11	3.56
27239022	40.188031	-80.792441	0.04	0.26	-0.47	-1.22	2.6
27239023	40.188145	-80.792546	0.07	0.51	-1.64	-4.26	2.38

27239024	40.18829	-80.792398	0.14	0.96	-0.2	-0.51	3.1
27239025	40.187987	-80.790771	0.48	3.3	1	2.6	4.91
27239026	40.187736	-80.790756	0.16	1.13	-0.71	-1.84	4.78
27239027	40.187623	-80.790642	-0.3	-2.07	-0.65	-1.68	4.69
27239028	40.187744	-80.790687	-0.96	-6.65	-1.15	-2.97	5.49
27239029	40.187623	-80.790644	-0.31	-2.11	0.82	2.13	4.05
27239030	40.187749	-80.790647	-0.44	-3.05	-0.36	-0.94	2.79
27239031	40.187868	-80.790715	-0.71	-4.89	-1.13	-2.94	3.85
27239032	40.189102	-80.788963	1.02	7.07	0.62	1.62	4.49
27239033	40.18923	-80.788952	0.64	4.4	-0.07	-0.18	2.7
27239034	40.189353	-80.788981	0.25	1.71	-0.03	-0.09	3.75
27239035	40.189107	-80.788928	0.63	4.33	0.17	0.44	3.65
27239036	40.189235	-80.788915	0.61	4.21	0.07	0.18	2.41
27239037	40.189363	-80.788901	0.45	3.14	-0.94	-2.44	4.34
27239038	40.189122	-80.788805	0.01	0.06	-1.21	-3.15	4.97
27239039	40.189241	-80.788866	0.61	4.18	0.62	1.61	3.73
27239040	40.190446	-80.787346	1.17	8.05	1.06	2.76	5.13
27239041	40.190576	-80.787324	-0.66	-4.55	-1.25	-3.23	4.2
27239042	40.1907	-80.787343	-0.89	-6.16	-1.21	-3.15	5.51
27239043	40.191008	-80.786912	0.58	3.97	1.5	3.9	4.86
27239044	40.187837	-80.79197	0.04	0.27	0.06	0.16	4.67
27239045	40.187967	-80.791943	-1.23	-8.52	0.07	0.19	4.17
27239046	40.188097	-80.791916	-1.83	-12.63	-0.18	-0.46	5.72
27239047	40.187841	-80.791936	-0.65	-4.5	-0.09	-0.23	4.4
27239048	40.187954	-80.792046	-0.57	-3.9	-1.03	-2.67	2.5
27239049	40.188095	-80.79193	-0.75	-5.19	-0.07	-0.18	3.59
27239050	40.187981	-80.79183	-1.06	-7.33	0	0	4.71
27239051	40.1881	-80.791892	-0.5	-3.46	0.52	1.35	5.51
27239052	40.187535	-80.790334	0.17	1.15	-1.34	-3.49	2.41
27239053	40.187665	-80.790311	0.12	0.81	-0.9	-2.34	2.39
27239054	40.187423	-80.79022	0.95	6.57	1.63	4.22	5.62
27239055	40.187553	-80.790191	0.84	5.8	-0.4	-1.03	4.32
27239056	40.187683	-80.790162	0.9	6.2	-1.13	-2.93	4.65
27239057	40.187808	-80.790179	0.41	2.81	-3.84	-9.96	5.08
27239058	40.187428	-80.79018	1.14	7.89	-0.35	-0.9	5.25
27239059	40.187558	-80.790156	1.04	7.15	-0.28	-0.73	4.74
27239060	40.187686	-80.790144	1.04	7.19	-0.22	-0.57	4.74
27239061	40.187821	-80.790079	0.41	2.81	-0.67	-1.75	4.28
27239062	40.188037	-80.790379	-2.26	-15.54	-0.9	-2.33	7.33
27239063	40.187428	-80.790179	0.84	5.8	0.29	0.75	4.53
27239064	40.18756	-80.790136	0.91	6.28	-0.04	-0.11	4.4
27239065	40.187687	-80.790134	0.96	6.63	-0.01	-0.03	4.82
27239066	40.18781	-80.790162	-0.99	-6.84	-0.13	-0.33	5.51
27239068	40.189411	-80.788524	0.6	4.11	-0.61	-1.59	4.18
27239069	40.18952	-80.788663	0.35	2.44	-1.25	-3.25	2.66
27239070	40.189662	-80.788542	0.51	3.53	-0.46	-1.19	2.45
27239071	40.189414	-80.788498	-0.11	-0.73	-0.79	-2.05	3.4
27239072	40.189525	-80.788622	0.2	1.39	-2.07	-5.37	2.38
27239073	40.189667	-80.788505	0.49	3.35	-0.99	-2.57	2.74
27239074	40.18989	-80.788747	1.36	9.39	0.48	1.24	5.77
27239075	40.190741	-80.787016	0.5	3.44	2.02	5.25	5.42
27239076	40.19061	-80.787049	0.51	3.53	0.91	2.35	4.84
27239077	40.190746	-80.786982	1.17	8.06	1.19	3.1	5.39
27239078	40.190746	-80.786976	1.2	8.26	2.01	5.21	5.62
27239079	40.19087	-80.787	-0.62	-4.25	-2.73	-7.08	5.26
27239080	40.190993	-80.787028	0.96	6.66	0.24	0.62	5.54
27239081	40.187927	-80.790247	-1.89	-13	-0.2	-0.52	7.66
27239082	40.188865	-80.788836	0.34	2.32	0.54	1.39	1.69
27239083	40.18903	-80.788526	0.39	2.72	-0.05	-0.12	2.5
27239084	40.189038	-80.788463	0.25	1.75	-0.27	-0.69	2.84
27239085	40.189154	-80.78855	0.58	4.03	0.72	1.88	2.76
27239086	40.189006	-80.788724	0.36	2.47	-0.06	-0.15	2.12
27239121	40.20346	-80.769569	-1.98	-13.67	-4.57	-11.85	2.48
27239122	40.203462	-80.769552	-1.61	-11.11	-4.47	-11.6	2.6

APPENDIX D Monroe East SR 78

Id	Lat	Lon	Cumul_Vel	Cumul_disp	AU20-SP23 Cumul_Vel	AU202-SP23 Cumul_disp	Stdev
27239200	39.751179	-81.058321	-0.2	-1.41	-0.54	-1.41	4.75
27239201	39.750935	-81.058241	-0.14	-0.96	0.28	0.72	3.39
27239202	39.751067	-81.058207	-0.13	-0.89	0.18	0.46	2.76
27239203	39.751203	-81.058135	-0.13	-0.91	-0.31	-0.8	4.81
27239204	39.751563	-81.059278	-0.11	-0.76	-0.34	-0.87	1.94
27239205	39.751689	-81.059289	0.3	2.09	-0.25	-0.65	1.61
27239206	39.751561	-81.059292	-0.1	-0.7	-0.85	-2.22	1.72
27239207	39.751689	-81.059289	0.14	0.96	-0.55	-1.42	1.39
27239208	39.751818	-81.059272	0.17	1.18	0.47	1.22	2.9
27239209	39.750817	-81.059158	-0.47	-3.23	-2.16	-5.59	4.69
27239210	39.751565	-81.059261	-0.3	-2.07	-0.74	-1.93	1.76
27239211	39.75169	-81.059278	0.16	1.09	-0.47	-1.22	1.4
27239212	39.751818	-81.059272	0.05	0.33	0.27	0.69	2.87
27239213	39.751575	-81.059188	-0.15	-1.04	0.19	0.48	2.87
27239214	39.751696	-81.059233	0.05	0.36	0.28	0.73	2.18
27239215	39.751828	-81.059198	0.24	1.63	1.25	3.24	4.39
27239216	39.75271	-81.054352	-0.2	-1.4	-0.58	-1.5	5.19
27239217	39.752722	-81.054255	-1.72	-11.85	-2.38	-6.19	5.72
27239218	39.75285	-81.054246	-1.89	-13.01	-3.11	-8.07	5.64
27239219	39.752728	-81.05421	-1.42	-9.77	-2.47	-6.41	5.88
27239220	39.751059	-81.058263	-0.21	-1.43	1.02	2.64	4.72
27239221	39.751182	-81.058294	0.23	1.6	0.77	2	4.64
27239222	39.751891	-81.058708	2.85	19.64	-0.34	-0.88	9.07
27239223	39.750935	-81.058243	-0.42	-2.92	-0.79	-2.04	1.72
27239224	39.751056	-81.058286	0	0	-0.05	-0.13	1.05
27239225	39.75118	-81.058311	-0.1	-0.71	0.05	0.14	1.71
27239226	39.751308	-81.058307	0.01	0.08	-0.02	-0.05	4.71
27239227	39.750811	-81.058222	-0.27	-1.89	-3.28	-8.5	5.36
27239228	39.750935	-81.058241	-0.08	-0.56	0.02	0.05	2.36
27239229	39.751062	-81.058242	-0.08	-0.56	-0.51	-1.33	1.75
27239230	39.751184	-81.05828	-0.27	-1.87	0	0.01	1.97
27239231	39.751301	-81.058356	-0.38	-2.62	0.18	0.47	5.16
27239232	39.751039	-81.059402	0.87	5.98	0.13	0.35	5.03
27239233	39.751165	-81.059413	0.62	4.3	1.38	3.57	4.68
27239234	39.751052	-81.0593	0.69	4.77	1.41	3.66	5.16
27239235	39.75066	-81.058408	-4.78	-32.95	-3.17	-8.22	10.86
27239236	39.752019	-81.058697	3.1	21.36	-1.07	-2.77	9.84
27239237	39.750643	-81.058537	-9.05	-62.37	-4.81	-12.49	15.79
27239238	39.750698	-81.055172	-4.46	-30.75	-2.26	-5.85	10
27239239	39.750825	-81.055176	-0.4	-2.76	-0.98	-2.55	4.33
27239240	39.750223	-81.054916	-8.03	-55.34	-3.17	-8.24	19.48
27239241	39.750552	-81.058259	-10.73	-73.91	-9.69	-25.13	28.73
27239242	39.750468	-81.057927	-11.17	-76.97	-8.67	-22.51	22.81
27239243	39.750942	-81.055253	-3.91	-26.93	1.07	2.77	9.75
27239244	39.753284	-81.042079	-1.68	-11.57	-0.37	-0.97	4.06
27239245	39.75341	-81.042093	-1.73	-11.9	0.04	0.11	3.72
27239246	39.752999	-81.04134	0.58	3.99	-0.12	-0.3	5.2
27239247	39.753123	-81.041367	0.39	2.66	-1	-2.6	5.21
27239248	39.753014	-81.041223	0.78	5.38	0.28	0.73	5.17
27239249	39.75313	-81.041314	0.49	3.36	0.26	0.67	4.71
27239250	39.753092	-81.040621	0.46	3.17	-0.46	-1.19	5.03
27239251	39.75323	-81.040541	-0.2	-1.35	-0.83	-2.14	5.06
27239252	39.753843	-81.040707	1.11	4.2	0.76	1.98	2.22
27239253	39.75397	-81.040707	1.05	3.96	0.32	0.83	2.6
27239254	39.753842	-81.040721	0.45	1.71	-0.67	-1.73	1.9

27239255	39.75397	-81.040707	-0.31	-1.19	-0.7	-1.82	2.22
27239256	39.754371	-81.044475	-2.4	-16.57	-2.91	-7.55	6.05
27239257	39.754494	-81.044503	-2.1	-14.46	-2.59	-6.72	5.27
27239258	39.75437	-81.044485	-3.51	-24.15	-3	-7.78	5.7
27239259	39.754498	-81.044479	-1.92	-13.23	-2.22	-5.76	4.51
27239260	39.754625	-81.044472	-1.67	-11.49	-2.37	-6.14	4.41
27239261	39.754372	-81.044469	-2.93	-20.17	-2.73	-7.09	5.49
27239262	39.754494	-81.044508	-1.53	-10.52	-2.1	-5.46	5.29
27239263	39.754618	-81.044527	-1.7	-11.71	-2.81	-7.3	5.62
27239264	39.753688	-81.043864	-0.91	-5.79	0.6	1.55	4.78
27239265	39.753455	-81.043699	-0.2	-1.14	1.04	2.71	3.39
27239266	39.753581	-81.043705	0	0	0	0	0
27239267	39.753701	-81.043761	0.33	2.08	0.1	0.25	3.42
27239268	39.753586	-81.043673	-0.56	-3.52	0.38	0.99	2.73
27239269	39.753714	-81.043665	-0.45	-2.82	0.05	0.13	2.7
27239270	39.753555	-81.043907	0.05	0.24	-0.23	-0.59	2.22
27239271	39.753683	-81.043901	0.08	0.38	-0.04	-0.09	2.28
27239272	39.753557	-81.043894	0.14	0.65	-0.33	-0.85	2.26
27239273	39.753685	-81.043889	0.03	0.15	-0.29	-0.74	2.35
27239274	39.753961	-81.040779	-3.53	-2.54	-5.79	-15.03	1.43
27239275	39.753289	-81.042044	-3.17	-21.78	-1	-2.59	4.97

APPENDIX D Monroe West SR 78

Id	Lat	Lon	Cumul_Vel	Cumul_disp	AU20-SPR23 Cumul_Vel	AU20-SP23 Cumul_disp	Stdev
27241112	39.775015	-81.150395	-1.05	-7.26	0.85	2.21	4.75
27241113	39.775149	-81.150342	-1.25	-8.64	-0.14	-0.36	5.59
27241114	39.774433	-81.146091	-0.49	-3.34	-0.87	-2.27	4.64
27241115	39.77456	-81.146095	-0.4	-2.75	-0.96	-2.5	2.8
27241116	39.774686	-81.146103	-0.45	-3.1	-0.89	-2.3	2.84
27241117	39.776909	-81.146592	-2.39	-16.46	-0.62	-1.62	4.2
27241118	39.777027	-81.146659	-1.63	-11.26	-0.88	-2.28	3.82
27241119	39.774561	-81.146082	-0.51	-3.5	-1.6	-4.14	3.05
27241120	39.774688	-81.146088	-0.57	-3.9	-1.89	-4.9	2.82
27241121	39.77691	-81.146583	-1.77	-12.17	0.55	1.42	4.33
27241122	39.777032	-81.14662	-1.08	-7.48	-0.13	-0.35	4.64
27241123	39.774252	-81.144556	-1.19	-8.2	-1.36	-3.52	4.86
27241124	39.774379	-81.144557	-0.56	-3.86	-0.39	-1.01	4.1
27241125	39.775372	-81.144739	-0.03	-0.18	0.61	1.59	4.92
27241126	39.774258	-81.144508	-0.98	-6.8	-1.27	-3.29	5.47
27241127	39.77439	-81.144476	-0.87	-5.97	-0.55	-1.43	4.41
27241128	39.774997	-81.15054	0.94	6.42	0.42	1.09	4.75
27241129	39.774875	-81.1505	-0.04	-0.26	-0.48	-1.25	2.75
27241130	39.775001	-81.150502	0	0	-0.03	-0.09	1.3
27241131	39.775129	-81.150502	-0.01	-0.07	0.03	0.07	3.33
27241132	39.774875	-81.150495	-0.49	-3.4	-0.7	-1.82	3.77
27241133	39.775007	-81.150461	-0.91	-6.27	0.11	0.3	2.44
27241134	39.775133	-81.150471	-0.74	-5.1	0.4	1.03	3.41
27241135	39.775877	-81.14866	-0.92	-6.23	0.76	1.98	4.92
27241136	39.775883	-81.148614	-1.33	-9.17	0.96	2.49	5.75
27241137	39.777245	-81.146937	-0.86	-5.92	-1.33	-3.46	5.35
27241138	39.777364	-81.147004	-4.82	-33.22	-14.59	-37.85	12.65
27241139	39.777495	-81.14697	-1.15	-7.93	1.33	3.44	4.89
27241140	39.77772	-81.147192	-1.63	-11.24	-0.24	-0.63	6.25
27241141	39.777852	-81.147154	-2.67	-18.4	-0.92	-2.4	6.91
27241142	39.777245	-81.14694	-0.88	-6.09	-0.32	-0.82	3.33
27241143	39.777371	-81.146946	-1.06	-7.32	0.2	0.53	2.65
27241144	39.777499	-81.146939	-1.02	-7	0.74	1.92	3.1
27241145	39.776088	-81.146067	-0.03	-0.2	0.11	0.27	3.43
27241146	39.776222	-81.146013	-0.11	-0.74	-0.41	-1.06	2.88
27241147	39.776095	-81.146016	0.4	2.74	1.46	3.79	4.4
27241148	39.776221	-81.146021	-0.08	-0.56	1.71	4.43	2.81
27241149	39.776351	-81.145999	-0.42	-2.86	0.85	2.21	5.04
27241150	39.774247	-81.152389	-1.6	-11	-1.71	-4.44	2.85
27241151	39.774372	-81.152407	-1.33	-9.15	-0.84	-2.19	2.44
27241152	39.774496	-81.152427	-0.28	-1.92	-0.44	-1.13	2.89
27241153	39.774253	-81.152343	-1.69	-11.66	-1.6	-4.16	4.59
27241154	39.775873	-81.148691	-0.64	-4.39	-0.63	-1.62	5.62
27241155	39.775868	-81.148729	-0.49	-3.35	0.74	1.93	5.22
27241156	39.777256	-81.146855	-0.82	-5.67	-0.26	-0.67	3.96
27241157	39.777377	-81.146899	-1.18	-8.14	-0.55	-1.43	2.51
27241158	39.777501	-81.146927	-0.95	-6.54	-0.21	-0.56	2.52
27241159	39.77738	-81.146875	-1.18	-8.11	-0.82	-2.12	3.36
27241160	39.777509	-81.146864	-1.3	-9	-0.18	-0.48	4.23
27241161	39.774673	-81.150097	0.27	1.84	-0.8	-2.08	5.25
27241162	39.774827	-81.149894	-0.21	-1.44	-0.79	-2.04	4.47
27241163	39.775708	-81.145081	-0.41	-2.83	-0.55	-1.44	2.66
27241164	39.775714	-81.145041	0.7	4.85	-1.17	-3.02	4.33
27241165	39.774225	-81.152558	-0.83	-5.75	-0.5	-1.3	4.66
27241166	39.774358	-81.152514	-0.98	-6.77	-0.46	-1.19	2.99

27241167	39.774484	-81.152519	-1.71	-11.75	0	0.01	4
27241168	39.774223	-81.152577	-1.52	-10.46	-1.77	-4.59	4.68
27241169	39.774354	-81.152544	-1.75	-12.06	-0.95	-2.46	3.54
27241170	39.774236	-81.152476	-1.93	-13.29	-1.88	-4.89	3.45
27241171	39.774362	-81.152484	-1.7	-11.7	-1.44	-3.74	3.21
27241172	39.774487	-81.152495	-1.4	-9.68	-1.46	-3.8	3.45
27241173	39.774564	-81.146058	-0.43	-2.89	-1.58	-4.11	3.63
27241174	39.774693	-81.146049	-0.44	-3.01	-1.27	-3.28	3.44
27241175	39.774578	-81.145955	-1.08	-7.45	-1.27	-3.29	5.6
27241176	39.774702	-81.145981	-0.48	-3.31	-1.16	-3.02	5.43
27241177	39.774372	-81.152404	-1.28	-8.84	0.01	0.04	5.38
27241178	39.774499	-81.152404	-1.62	-11.17	-0.21	-0.54	5.59
27241179	39.777718	-81.147212	-1.73	-11.95	-0.71	-1.83	6.38
27241180	39.777852	-81.147158	-2.71	-18.68	-1.18	-3.06	6.81
27241181	39.777055	-81.146446	-0.74	-5.12	-0.22	-0.56	5.06
27241182	39.775841	-81.145038	-1.25	-8.62	-1.66	-4.3	5.15
27241183	39.775961	-81.145093	-0.59	-4.1	-0.37	-0.96	4.86
27241184	39.777017	-81.146734	-0.75	-5.19	-0.53	-1.39	4.53
27241185	39.777144	-81.14674	-0.82	-5.68	-0.1	-0.25	5.65
27241186	39.777015	-81.146754	-0.53	-3.67	-0.96	-2.5	3.65
27241187	39.777141	-81.14676	-0.53	-3.63	-0.1	-0.26	3.79
27241188	39.777389	-81.146808	-0.95	-6.58	-0.31	-0.81	3.38
27241189	39.777514	-81.146825	-1.03	-7.11	-0.55	-1.43	3.49
27241190	39.774425	-81.146151	-0.08	-0.55	3.37	8.73	5.04
27241191	39.774554	-81.146138	-0.07	-0.46	0.56	1.46	3.67
27241192	39.774679	-81.146155	-0.22	-1.52	-0.61	-1.59	4.66
27241193	39.777021	-81.14671	-0.38	-2.64	-1.2	-3.1	3.83
27241194	39.777143	-81.146745	-0.4	-2.73	-2.01	-5.21	3.79
27241195	39.776118	-81.145841	-0.15	-1.03	-0.53	-1.38	4.92
27241196	39.776233	-81.145928	-0.03	-0.18	0.39	1	3.82
27241197	39.776238	-81.145891	0.28	1.91	-0.04	-0.1	4.98
27241198	39.775718	-81.145005	0.18	1.26	-0.8	-2.08	4.69
27241199	39.77583	-81.145122	-0.69	-4.75	-0.52	-1.35	5.33
27241200	39.774469	-81.145816	-0.44	-2	-1.82	-4.72	4.15
27241201	39.774347	-81.145774	-0.86	-4	-1.35	-3.5	3.89
27241202	39.774473	-81.145788	-0.66	-2.99	-0.65	-1.7	3.1
27241203	39.774479	-81.152555	-1.43	-9.83	-0.67	-1.74	3.38

APPENDIX D

Monroe SR 7

Id	Lat	Lon	Cumul_Vel	Cumul_disp	AU202-SP23 Cumul_Vel	AU202-SP23 Cumul_disp	Stdev
27240198	39.700189	-80.85547	-1.2	-8.27	-2.56	-6.63	5.58
27240199	39.702691	-80.855752	-0.14	-0.96	0.34	0.88	4.8
27240200	39.700195	-80.855428	-0.71	-4.88	-0.72	-1.87	5.25
27240201	39.700243	-80.854063	0.15	1.05	0.13	0.33	5.08
27240202	39.700991	-80.854168	-1.16	-7.9	-2.04	-5.3	4.97
27240203	39.701113	-80.854207	-0.62	-4.25	-0.87	-2.26	4.91
27240204	39.702222	-80.854466	-0.72	-4.94	-0.23	-0.6	5.36
27240205	39.702347	-80.854476	-0.2	-1.41	-0.52	-1.34	5.35
27240206	39.700995	-80.854137	-0.55	-3.64	-1.17	-3.03	4.11
27240207	39.701119	-80.854161	-0.57	-3.94	-1.58	-4.11	4.07
27240208	39.701736	-80.854298	-1.07	-7.38	-0.89	-2.3	4.52
27240209	39.701868	-80.854253	-0.69	-4.78	-0.84	-2.17	5.2
27240210	39.700993	-80.854154	-0.41	-2.83	-2.5	-6.48	4.66
27240211	39.701126	-80.854103	-1.1	-7.6	-0.59	-1.52	5.51
27240212	39.702113	-80.854324	-1.14	-7.83	0.64	1.66	4.88
27240213	39.700012	-80.853881	-0.01	-0.1	1.71	4.43	5.16
27240214	39.701255	-80.854084	1.47	10.12	1.74	4.52	6.15
27240215	39.701378	-80.854114	-0.72	-4.99	-0.57	-1.48	5.31
27240216	39.701991	-80.854287	-0.13	-0.87	0.27	0.7	4.84
27240217	39.702113	-80.854324	-0.53	-3.64	-0.05	-0.13	4.9
27240218	39.702366	-80.854332	0.65	4.49	1.62	4.2	5.14
27240219	39.702494	-80.854321	-0.51	-3.53	-0.6	-1.56	5.35
27240220	39.701376	-80.854136	-0.76	-5.25	0.46	1.18	5.44
27240221	39.702121	-80.854267	-0.1	-0.71	0.76	1.97	4.93
27240222	39.70077	-80.851927	-0.17	-1.18	2.02	5.23	5.26
27240223	39.7009	-80.851902	-0.2	-1.39	-0.86	-2.24	4.99
27240224	39.701137	-80.85204	-0.47	-3.15	-0.2	-0.53	4.85
27240225	39.70136	-80.852276	-0.84	-5.83	-1.08	-2.81	5.37
27240226	39.701741	-80.852279	-3.25	-22.36	-1.29	-3.35	6.61
27240227	39.702122	-80.852278	-0.33	-2.25	-0.8	-2.06	5.23
27240228	39.702855	-80.852496	-0.13	-0.87	-0.04	-0.09	2.76
27240229	39.702975	-80.852555	0.14	0.98	-0.04	-0.12	3.46
27240230	39.700762	-80.851992	-0.21	-1.45	1.17	3.05	3.16
27240231	39.700897	-80.851929	0.46	3.17	0.82	2.14	3.68
27240232	39.701026	-80.851913	-0.27	-1.85	-1.2	-3.11	4.28
27240233	39.701151	-80.851923	-0.09	-0.62	-0.32	-0.83	3.62
27240234	39.701273	-80.851963	-0.09	-0.64	-1.14	-2.97	5.15
27240235	39.702603	-80.852485	0.39	2.7	-1.21	-3.15	4.28
27240236	39.702864	-80.852424	-1.35	-9.32	0.53	1.38	5.01
27240237	39.702984	-80.852478	-0.62	-4.26	-0.19	-0.48	3.28
27240238	39.700762	-80.851997	-0.11	-0.73	1.18	3.05	4.03
27240239	39.700895	-80.851944	0.17	1.16	-0.54	-1.4	3.96
27240240	39.701134	-80.852064	0.15	1.06	-0.01	-0.03	4.17
27240241	39.702627	-80.852299	0.35	2.38	0.68	1.76	4.99
27240242	39.700903	-80.851881	-0.12	-0.8	0.06	0.15	4.43
27240243	39.701021	-80.851951	0.26	1.71	0.47	1.23	3.52
27240244	39.701269	-80.851997	-0.03	-0.2	-1.9	-4.93	3.99
27240245	39.701403	-80.851945	0.17	1.19	-1.56	-4.05	4.14
27240246	39.702862	-80.852442	1.12	7.71	3.61	9.36	5.37
27240247	39.702998	-80.852369	0.17	1.2	0.11	0.29	3.13
27240248	39.703123	-80.852385	-0.42	-2.86	-2.79	-7.25	4.62
27240249	39.703375	-80.852397	-0.58	-4.03	-0.06	-0.15	5
27240250	39.703726	-80.852631	0.18	1.23	-0.3	-0.78	4.9
27240251	39.701341	-80.851439	0.56	3.86	-0.44	-1.13	2.83
27240252	39.701457	-80.851525	0.75	5.03	-0.75	-1.94	3.63
27240253	39.70158	-80.851551	1.04	6.99	-0.29	-0.74	4.77

27240254	39.701688	-80.851702	0.14	0.99	0.58	1.49	4.78
27240255	39.701835	-80.851546	1.05	7.26	0.42	1.1	4.75
27240256	39.701953	-80.851616	0.62	4.3	0.87	2.26	4.54
27240257	39.702069	-80.8517	0.48	3.28	0.99	2.57	4.38
27240258	39.702301	-80.851867	0.37	2.56	-1.2	-3.11	5.31
27240259	39.702677	-80.851909	-0.7	-4.76	-1.34	-3.48	4.5
27240260	39.702803	-80.851918	-0.37	-2.54	0.4	1.04	4.44
27240261	39.702937	-80.851854	-0.83	-5.7	-0.26	-0.68	5.24
27240262	39.70318	-80.851941	-0.16	-1.08	0.06	0.15	1.86
27240263	39.703305	-80.851961	0	0	0.28	0.72	1.46
27240264	39.703431	-80.851968	0.09	0.59	0.19	0.5	1.32
27240265	39.703557	-80.851976	0.2	1.39	0.34	0.89	2.16
27240266	39.70381	-80.85198	-0.1	-0.7	0.05	0.13	3.51
27240267	39.704172	-80.852123	0.09	0.6	0.13	0.33	2.87
27240268	39.7043	-80.852116	0.01	0.08	-0.13	-0.35	4.3
27240269	39.701333	-80.851502	0.59	3.92	0.97	2.52	4.78
27240270	39.701455	-80.851538	0.37	2.47	0.11	0.28	3.92
27240271	39.701582	-80.851541	0.31	2.11	0.29	0.75	4.49
27240272	39.701719	-80.851456	1.5	10.36	2.51	6.51	5.81
27240273	39.701844	-80.851474	0.65	4.49	0.15	0.39	3.29
27240274	39.70197	-80.851477	0.68	4.67	1.35	3.5	3.9
27240275	39.702071	-80.851686	0.25	1.75	1.97	5.1	4.81
27240276	39.702684	-80.851855	-0.43	-2.94	-0.3	-0.79	4.84
27240277	39.703185	-80.851905	0.15	1.05	-0.07	-0.19	4.2
27240278	39.703308	-80.851932	-0.18	-1.26	-0.16	-0.4	2.04
27240279	39.703434	-80.851942	-0.12	-0.85	0.42	1.09	1.78
27240280	39.703551	-80.852018	0.46	3.2	0.25	0.66	3.81
27240281	39.703817	-80.851927	-0.07	-0.45	0.56	1.46	3.99
27240282	39.704171	-80.852133	0.69	4.73	0.61	1.58	4.17
27240283	39.704309	-80.852049	0.9	6.18	0.22	0.58	5.11
27240284	39.701481	-80.851332	0.87	5.95	2.11	5.48	3.45
27240285	39.701713	-80.851502	-0.15	-1.06	1.11	2.89	5.04
27240286	39.701957	-80.851586	1.74	12	2.14	5.55	3.79
27240287	39.702095	-80.851492	0.56	3.85	-0.2	-0.51	3.63
27240288	39.703315	-80.851878	0.4	1.66	0.3	0.78	1.11
27240289	39.703443	-80.851867	-0.18	-0.72	0.38	0.99	1.15
27240290	39.703703	-80.851826	0.63	4.34	-1.27	-3.29	5.28
27240291	39.701467	-80.851442	-0.28	-1.9	-1.27	-3.3	2.79
27240292	39.701592	-80.851461	-0.31	-2.13	-0.77	-1.99	3.07
27240293	39.70172	-80.851453	-0.42	-2.92	0.32	0.82	3.82
27240294	39.701846	-80.85146	1.45	9.98	1.66	4.31	5.22
27240295	39.701971	-80.85147	1.05	7.21	0.63	1.64	3.03
27240296	39.702094	-80.851505	0.91	6.28	-0.06	-0.17	2.9
27240297	39.70246	-80.851618	0.22	1.5	-1.63	-4.24	5.38
27240298	39.703441	-80.851884	-2.11	-12.89	0.21	0.55	5.58
27240299	39.703576	-80.851825	-1.16	-8.01	2.51	6.51	5.51
27240300	39.703706	-80.851798	0.33	2.3	-0.89	-2.32	4.34
27240301	39.703948	-80.851895	0.04	0.28	1.1	2.86	4.6
27240302	39.701502	-80.851168	-0.19	-1.34	-0.29	-0.74	2.78
27240303	39.701621	-80.851227	-0.04	-0.25	0.38	0.99	3.02
27240304	39.701732	-80.851353	0.02	0.12	0.16	0.41	3.52
27240305	39.702709	-80.851659	0.02	0.16	-0.56	-1.46	5.05
27240306	39.703211	-80.851702	0.06	0.41	0.05	0.13	3.45
27240307	39.703324	-80.851812	0.11	0.76	0.53	1.38	3.08
27240308	39.704065	-80.851967	-0.81	-5.57	-0.43	-1.11	4.87
27240309	39.702311	-80.850798	1.57	10.82	1.8	4.66	3.89
27240310	39.702446	-80.850737	0.39	2.69	1.91	4.95	4.98

27240311	39.702558	-80.850853	0.49	3.28	0.49	1.27	4.04
27240312	39.703077	-80.850767	0.94	6.48	4.91	12.74	5.23
27240313	39.703307	-80.850953	0.24	1.68	0.55	1.44	3.83
27240314	39.703435	-80.850943	0.2	1.37	0.49	1.26	3.81
27240315	39.703563	-80.850936	-0.09	-0.58	0.73	1.89	4.23
27240316	39.7038	-80.851063	1.37	9.43	1.98	5.14	5.6
27240317	39.703942	-80.85095	0.73	5.07	1.32	3.43	4.75
27240318	39.702433	-80.850841	0.63	4.38	0.47	1.23	4.87
27240319	39.70255	-80.850914	0.3	2.1	-0.81	-2.11	4.45
27240320	39.702702	-80.850719	0.37	2.54	0.3	0.77	4.55
27240321	39.703313	-80.850903	0.17	1.18	0.57	1.48	3.85
27240322	39.703439	-80.850909	0.24	1.66	0.68	1.76	3.83
27240323	39.703568	-80.850897	0.27	1.83	1.04	2.7	3.92
27240324	39.703675	-80.85105	0.39	2.68	1.7	4.41	4.33
27240325	39.703803	-80.851043	0.25	1.72	2.38	6.17	4.93
27240326	39.703947	-80.850908	0.58	4	1.2	3.12	4.79
27240327	39.704321	-80.850961	0.57	3.94	1.84	4.76	5.35
27240328	39.702326	-80.850686	1.03	7.1	1.48	3.85	4.88
27240329	39.70256	-80.850837	0.96	6.58	2.22	5.77	3.62
27240330	39.702831	-80.850704	0.24	1.65	0.01	0.02	4.9
27240331	39.702945	-80.850808	0.05	0.36	-0.61	-1.58	2.44
27240332	39.703078	-80.85076	0.16	1.13	1.28	3.32	3.25
27240333	39.703202	-80.850776	0.1	0.71	1.39	3.62	3.39
27240334	39.703321	-80.850845	0.09	0.63	0.9	2.34	3.42
27240335	39.703438	-80.850921	0.18	1.23	1.43	3.71	3.9
27240336	39.703563	-80.850932	0.34	2.38	1.3	3.38	4.36
27240337	39.703676	-80.851044	1.3	8.97	0.31	0.8	5.55
27240338	39.703811	-80.85098	1.15	7.96	3.18	8.26	5.73
27240339	39.703289	-80.850098	-0.36	-2.49	-0.71	-1.84	4.98
27240340	39.703152	-80.850184	0.42	2.87	1.13	2.94	5.2
27240341	39.700449	-80.857402	2.89	19.89	-1.36	-3.52	9.28
27240342	39.700704	-80.857398	0.67	4.59	-1.19	-3.09	5.29
27240343	39.700096	-80.856201	-1.36	-9.4	-1.87	-4.86	5.74
27240344	39.700212	-80.856285	-0.91	-6.29	-1.69	-4.39	5.64
27240345	39.700098	-80.856187	-1.87	-12.89	-1.15	-2.98	6.38
27240346	39.701705	-80.854541	0.45	3.12	-0.82	-2.12	5.3
27240347	39.700596	-80.854282	0.21	1.43	0.91	2.37	4.98
27240348	39.700704	-80.854423	-0.11	-0.73	-1.35	-3.51	5.32
27240349	39.701105	-80.854268	0.87	5.99	-1.06	-2.75	5.38
27240350	39.701705	-80.854537	0.46	3.15	-2.49	-6.46	5.19
27240351	39.700599	-80.854257	-0.37	-2.53	0.37	0.97	4.72
27240352	39.70109	-80.854387	0.21	1.47	-0.05	-0.14	4.81
27240353	39.700232	-80.854147	-0.28	-1.91	0.59	1.54	5.26
27240354	39.700363	-80.854117	0.02	0.14	0.98	2.55	5.17
27240355	39.702346	-80.85449	-0.36	-1.56	-1.19	-3.08	3.4
27240356	39.70023	-80.854163	0.8	5.5	-0.16	-0.42	5.76
27240357	39.702221	-80.854473	-0.64	-2.47	-0.37	-0.95	2.13
27240358	39.702345	-80.854496	-0.12	-0.49	-0.38	-0.97	2.39
27240359	39.700296	-80.852654	-0.71	-4.91	-1.24	-3.22	5.33
27240360	39.701156	-80.852881	0.74	5.08	-0.75	-1.94	5.43
27240361	39.702888	-80.853227	1.46	10.08	3.2	8.3	5.82
27240362	39.703255	-80.853335	-0.38	-2.6	0.01	0.02	4.05
27240363	39.703372	-80.853417	-0.28	-1.9	1.35	3.49	4.28
27240364	39.703513	-80.853305	0.37	2.58	2.27	5.88	5.18
27240365	39.70017	-80.852654	0.72	4.99	0.03	0.08	5.03
27240366	39.700277	-80.85281	0.15	1.02	-1.49	-3.86	4.26
27240367	39.700911	-80.852811	1.48	10.21	1.06	2.76	6.14

27240368	39.701026	-80.852904	1.13	7.81	0.37	0.95	5.72
27240369	39.700294	-80.852675	0.59	4.06	-0.82	-2.14	4.65
27240370	39.700427	-80.852626	0.36	2.47	-0.62	-1.61	4.15
27240371	39.702427	-80.85286	-0.15	-1.05	0.39	1	5.03
27240372	39.70289	-80.853218	-1.44	-9.92	-1.49	-3.86	5.86
27240373	39.703271	-80.853212	-0.4	-2.74	1.11	2.89	4.6
27240374	39.703523	-80.853228	0.61	4.21	-0.03	-0.07	3.5
27240375	39.703649	-80.853236	0.66	4.54	0.68	1.77	3.48
27240376	39.70355	-80.853014	0.65	4.49	1.08	2.81	5.54
27240377	39.700479	-80.852222	0.72	5	-2.59	-6.73	5.08
27240378	39.701368	-80.852215	0.01	0.06	0.96	2.5	4.84
27240379	39.700493	-80.852112	0.32	2.18	2.41	6.25	5.09
27240380	39.700598	-80.852282	0.58	4.01	1.21	3.13	4.64
27240381	39.702702	-80.852697	0.4	2.74	0.57	1.48	4.41
27240382	39.702822	-80.852753	0.89	6.16	-0.03	-0.07	4.63
27240383	39.703552	-80.853003	0.64	4.44	-0.42	-1.09	4.58
27240384	39.702845	-80.852571	-0.11	-0.75	0.48	1.26	4.89
27240385	39.700618	-80.852126	0.25	1.71	0.25	0.65	4.57
27240386	39.701015	-80.852	0.38	2.6	0.78	2.04	5.11
27240387	39.701111	-80.852245	-1.72	-10.88	0.06	0.17	5.15
27240388	39.701363	-80.852254	-1.11	-7.68	-0.48	-1.26	5.57
27240389	39.702724	-80.852531	-0.65	-4.51	0.01	0.03	5.23
27240390	39.701369	-80.852209	-0.52	-3.08	-0.16	-0.41	4.09
27240391	39.700623	-80.852091	-0.54	-3.75	1.53	3.98	4.79
27240392	39.701027	-80.851907	1.06	7.3	-0.57	-1.48	4.81
27240393	39.701735	-80.852321	-2.79	-19.25	-0.13	-0.33	6.32
27240394	39.702856	-80.852487	-0.48	-3.3	-2.84	-7.38	5.03
27240395	39.702989	-80.852443	0.19	1.31	-1.97	-5.11	4.88
27240396	39.702032	-80.851	0.53	3.62	0.16	0.42	2.79
27240397	39.702156	-80.851021	0.62	4.28	0.19	0.48	2.28
27240398	39.702287	-80.850984	0.54	3.75	-0.18	-0.47	2.57
27240399	39.702532	-80.85106	0.13	0.88	0.87	2.27	2.59
27240400	39.702646	-80.851159	0.6	4.14	0.94	2.43	2.86
27240401	39.702765	-80.851224	0.53	3.66	0.62	1.61	3.56
27240402	39.702882	-80.851302	0.11	0.75	-0.03	-0.08	3.55
27240403	39.703007	-80.851315	0.22	1.49	0.72	1.87	3.23
27240404	39.703136	-80.851294	0.47	3.23	1.07	2.79	2.44
27240405	39.703258	-80.851338	-0.01	-0.05	0.55	1.43	4.57
27240406	39.703377	-80.851394	0.27	1.85	0.27	0.71	2.16
27240407	39.703507	-80.851375	0.23	1.62	0.35	0.91	2.47
27240408	39.703635	-80.851363	0.18	1.24	0.15	0.4	2.95
27240409	39.703766	-80.851333	0.19	1.25	-1.67	-4.34	3.65
27240410	39.704262	-80.851418	-0.35	-2.35	-1.37	-3.55	4.65
27240411	39.704385	-80.851453	-1.24	-8.56	-0.89	-2.31	5.53
27240412	39.70203	-80.851016	0.73	5.06	0.21	0.54	3.62
27240413	39.702155	-80.851029	0.62	4.26	0.4	1.04	2.12
27240414	39.702279	-80.851053	0.68	4.72	0.26	0.67	2.5
27240415	39.702397	-80.851123	0.47	3.23	0.79	2.06	3.58
27240416	39.702529	-80.851079	0.43	2.98	1.08	2.8	4.52
27240417	39.702641	-80.851201	0.3	2.04	0.6	1.56	4
27240418	39.702755	-80.851302	0.21	1.42	0.98	2.53	5.06
27240419	39.702891	-80.851224	0.31	2.16	0.42	1.08	2.15
27240420	39.703014	-80.851258	0.41	2.81	0.68	1.76	2.32
27240421	39.703135	-80.851303	0.37	2.52	1.07	2.77	2.96
27240422	39.703271	-80.851234	1.02	7.04	1.83	4.75	3.42
27240423	39.703393	-80.851273	0.61	4.18	0.5	1.3	2.93
27240424	39.70352	-80.851268	0.04	0.27	0.57	1.47	1.94

27240425	39.703646	-80.851281	-0.19	-1.32	1.33	3.45	2.21
27240426	39.703788	-80.85116	1.29	8.93	-1.04	-2.7	5.51
27240427	39.704029	-80.851258	0.31	2.17	0.14	0.37	4.38
27240428	39.70428	-80.851279	-1.35	-9.29	0.13	0.35	5.32
27240429	39.704395	-80.851372	2.02	13.97	2.69	6.98	6.3
27240430	39.702276	-80.851078	0.64	4.41	1.33	3.46	2.88
27240431	39.702408	-80.851031	0.7	4.85	1.29	3.34	3.47
27240432	39.702525	-80.851115	0.54	3.72	0.43	1.13	3.75
27240433	39.702641	-80.851198	0.21	1.45	0.24	0.62	4.75
27240434	39.702893	-80.851216	0.44	3.05	0.84	2.19	1.7
27240435	39.703023	-80.851191	0.58	3.97	0.8	2.08	1.88
27240436	39.703174	-80.851001	1.02	7.01	1.12	2.91	4.48
27240437	39.703266	-80.85127	0.78	5.38	0.93	2.41	2.92
27240438	39.703516	-80.851305	-0.78	-5.36	1.25	3.23	4.58
27240439	39.703647	-80.85127	-0.61	-4.18	1.64	4.25	3.99
27240440	39.703892	-80.851338	-1	-6.93	-1.97	-5.11	5.63
27240441	39.704034	-80.851217	1.15	7.94	1.54	4	5.88
27240442	39.702032	-80.850999	0.23	1.61	1.49	3.86	4.67
27240443	39.702151	-80.85106	0.91	6.25	1.48	3.84	4.77
27240444	39.702286	-80.851	0.17	1.2	1.11	2.88	3.67
27240445	39.702406	-80.851048	0.43	2.97	1.03	2.67	3.76
27240446	39.702531	-80.851068	0.5	3.48	1.05	2.72	3.83
27240447	39.702643	-80.851179	0.41	2.81	0.5	1.3	4.84
27240448	39.702791	-80.851016	0.78	5.41	1.59	4.13	3.01
27240449	39.703169	-80.851035	0.92	6.38	0.81	2.1	3.59
27240450	39.703283	-80.851141	1.03	7.13	1.33	3.45	4.73
27240451	39.703379	-80.851379	0.01	0.09	-1.55	-4.03	3.15
27240452	39.70426	-80.851437	-0.7	-4.79	-0.19	-0.5	4.84
27240453	39.704396	-80.851363	-0.78	-5.38	0.4	1.05	4.98
27240454	39.70276	-80.850269	0.02	0.15	-1.91	-4.96	3.55
27240455	39.70288	-80.850318	0.13	0.87	0.64	1.65	3.49
27240456	39.703005	-80.850337	-0.7	-4.84	0.67	1.75	5.3
27240457	39.70324	-80.850482	0.25	1.72	1.61	4.17	3.86
27240458	39.703345	-80.850659	-0.23	-1.56	-0.81	-2.1	4.95
27240459	39.703497	-80.850456	0.22	1.49	0.29	0.75	2.48
27240460	39.703621	-80.850482	0.08	0.52	0.21	0.54	1.97
27240461	39.703742	-80.850526	-0.06	-0.42	-0.92	-2.4	3.07
27240462	39.702855	-80.850515	1.04	7.2	3.63	9.41	5.33
27240463	39.70326	-80.850329	0.76	5.22	0.5	1.3	4.74
27240464	39.703628	-80.850423	-0.13	-0.93	0.26	0.67	3.62
27240465	39.703748	-80.850478	-0.08	-0.59	0.21	0.54	4.64
27240466	39.702737	-80.850448	0.2	1.37	0.7	1.82	5.14
27240467	39.702917	-80.850033	0.57	3.95	1.35	3.5	4.63
27240468	39.703063	-80.849884	-0.22	-1.51	0.28	0.73	4.96
27240469	39.703387	-80.850326	-0.23	-1.59	-0.94	-2.43	4.67
27240470	39.703068	-80.849843	0.64	4.4	-0.24	-0.61	4.73
27240471	39.703113	-80.850487	0.45	3.14	1.28	3.32	5.1
27240472	39.703517	-80.850306	0.31	2.15	-0.22	-0.56	4.11
27240473	39.703642	-80.850315	0.42	2.89	0.02	0.04	4.74
27240474	39.702909	-80.850092	0.14	0.97	0.09	0.22	4.34
27240475	39.703145	-80.850234	0.4	2.67	1.75	4.53	4.3
27240476	39.703527	-80.85022	0.39	2.69	-0.14	-0.35	1.93
27240477	39.703655	-80.850216	0.38	2.59	0.1	0.25	2.04
27240478	39.703786	-80.850183	0.18	1.24	1.53	3.96	4.01
27240479	39.700563	-80.852554	0.12	0.81	0.86	2.24	4.84
27240480	39.7034	-80.8532	-0.05	-0.36	-0.25	-0.66	3.53
27240481	39.703523	-80.853228	0.44	3.04	0.6	1.57	2.76

27240482	39.703652	-80.853208	0.64	4.43	0.65	1.68	3.29
27240483	39.701425	-80.852759	1.29	8.92	0.77	1.99	5.96
27240484	39.702546	-80.852926	0.58	3.98	0.37	0.95	5.53
27240485	39.702677	-80.852894	0.64	4.4	-0.35	-0.91	5.52
27240486	39.703405	-80.853161	0.33	2.27	0.05	0.13	3.25
27240487	39.703531	-80.853162	0.33	2.27	0.85	2.2	3.34
27240488	39.703657	-80.85317	-0.04	-0.31	-1.56	-4.05	2.73
27240489	39.703783	-80.853178	0.05	0.32	-1.68	-4.37	3.37
27240490	39.700453	-80.852425	0.14	0.97	-0.97	-2.53	5.53
27240491	39.702555	-80.852861	0.71	4.91	0.65	1.67	5.21
27240492	39.702667	-80.852975	0.76	5.22	1.1	2.85	5.43
27240493	39.703299	-80.85299	-0.28	-1.9	-2.42	-6.28	5.22
27240494	39.703414	-80.853086	0.32	2.19	-0.13	-0.33	3
27240495	39.703535	-80.853132	-0.14	-0.95	0.04	0.11	3.26
27240496	39.70366	-80.853147	-0.25	-1.69	-1.36	-3.53	2.86
27240497	39.70379	-80.853126	0.02	0.11	-1.32	-3.43	3.27
27240498	39.700583	-80.852397	1.02	7	0.62	1.6	4.47
27240499	39.700843	-80.852348	0.63	4.32	-1.04	-2.71	4.58
27240500	39.702433	-80.852822	-0.37	-2.54	-0.7	-1.82	5.11
27240501	39.703416	-80.85307	0.37	2.58	0.07	0.18	5.19
27240502	39.700463	-80.852342	0.35	2.41	-0.03	-0.09	3.62
27240503	39.700583	-80.852399	0.5	3.42	0.23	0.59	2.21
27240504	39.700708	-80.852411	0.69	4.74	0.63	1.63	4.3
27240505	39.700833	-80.852432	0.71	4.87	-0.85	-2.19	4.62
27240506	39.70158	-80.852543	-1.84	-12.66	-0.82	-2.13	6.24
27240507	39.702425	-80.852879	0.14	0.99	-0.84	-2.19	5.15
27240508	39.702554	-80.852867	-0.05	-0.31	-0.69	-1.78	4.53
27240509	39.700462	-80.852355	0.27	1.88	-1.02	-2.66	4.48
27240510	39.700589	-80.852356	0.28	1.91	-0.12	-0.32	2.36
27240511	39.700716	-80.852355	-0.46	-3.19	0.1	0.25	4.27
27240512	39.701016	-80.851996	-0.42	-2.89	-1.1	-2.85	4.59
27240513	39.701273	-80.851966	-0.6	-4.13	-1.85	-4.81	4.63
27240514	39.701393	-80.85202	-0.4	-2.79	-0.21	-0.56	5.2
27240515	39.702763	-80.852226	-0.48	-3.31	-2.89	-7.5	5.38
27240516	39.702999	-80.852366	-1.32	-9.13	-3.08	-7.99	5.37
27240517	39.703126	-80.852363	-0.75	-5.2	-2.38	-6.17	3.78
27240518	39.703729	-80.852609	-0.27	-1.87	-2.2	-5.7	4.81
27240519	39.703868	-80.852518	-0.45	-3.08	-1.37	-3.56	5.26
27240520	39.701874	-80.852232	1.17	8.05	0.44	1.14	5.46
27240521	39.70214	-80.852135	-0.89	-6.17	-2.82	-7.32	5.59
27240522	39.702877	-80.852326	-0.43	-2.94	-1.43	-3.71	4.84
27240523	39.703256	-80.852336	-0.14	-0.98	-3.06	-7.93	4.81
27240524	39.703396	-80.852238	-0.7	-4.84	0.01	0.03	5.39
27240525	39.701046	-80.851755	0.48	3.33	0.44	1.14	4.73
27240526	39.701183	-80.851679	-0.28	-1.93	0.2	0.51	4.18
27240527	39.701274	-80.851962	-2.83	-19.55	-1.9	-4.93	7.73
27240528	39.702519	-80.852145	0.01	0.09	-0.02	-0.04	4.74
27240529	39.702762	-80.852234	1.16	8.01	0.24	0.61	5.24
27240530	39.702885	-80.852265	-0.78	-5.37	-2.46	-6.39	4.36
27240531	39.703015	-80.85224	-0.36	-2.47	-2.06	-5.34	4.68
27240532	39.703277	-80.852173	0.18	1.23	0	-0.01	3.57
27240533	39.70341	-80.852125	0.31	2.12	-0.14	-0.36	4.4
27240534	39.700931	-80.85166	0.48	3.24	0.88	2.29	4.02
27240535	39.701289	-80.851839	0.4	2.76	1.42	3.7	3.18
27240536	39.701411	-80.851884	0.53	3.55	0.7	1.82	2.27
27240537	39.701541	-80.851856	0.78	5.39	0.61	1.58	2.38
27240538	39.701665	-80.851879	1.72	11.77	0.26	0.68	4.18

27240539	39.702767	-80.852192	-0.05	-0.34	-1.14	-2.96	4.7
27240540	39.703011	-80.852272	1.14	7.86	-2.3	-5.98	5.05
27240541	39.703124	-80.852381	0.72	4.94	0.8	2.08	5.21
27240542	39.703636	-80.852347	-0.21	-1.45	0.41	1.05	5.1
27240543	39.701508	-80.851123	0.17	1.19	-0.27	-0.71	2.95
27240544	39.701624	-80.851207	0.09	0.65	-0.72	-1.87	3.76
27240545	39.701864	-80.851318	0.61	4.12	0.19	0.5	4.5
27240546	39.701986	-80.851358	0.76	5.24	1.23	3.18	3.58
27240547	39.702715	-80.851613	-0.5	-3.48	-2.1	-5.45	3.82
27240548	39.70284	-80.851626	-0.07	-0.45	-0.28	-0.72	3.54
27240549	39.702967	-80.851625	-0.1	-0.7	-0.87	-2.26	4.34
27240550	39.703318	-80.851859	-2.01	-13.87	-2.86	-7.43	6.79
27240551	39.703447	-80.85184	-1.6	-11.01	-2.13	-5.53	5.11
27240552	39.70408	-80.851852	-0.32	-2.19	-1.21	-3.15	3.3
27240553	39.70421	-80.851827	0.32	2.2	-0.87	-2.26	3.47
27240554	39.701614	-80.851289	0.54	3.72	0.19	0.48	3.99
27240555	39.701743	-80.851268	0.77	5.33	-0.05	-0.12	4.19
27240556	39.701988	-80.851339	0.8	5.48	1.23	3.19	5.02
27240557	39.702364	-80.85138	0.63	4.37	0.22	0.56	5.17
27240558	39.702487	-80.85141	0.01	0.09	0.62	1.61	3.6
27240559	39.702598	-80.851528	0.07	0.51	-0.82	-2.12	3.51
27240560	39.702851	-80.851537	0.1	0.65	0.21	0.54	3.27
27240561	39.702985	-80.851483	0.05	0.36	-1.03	-2.67	3.56
27240562	39.703096	-80.851604	0.43	2.99	0.7	1.83	2.94
27240563	39.703224	-80.851597	0.24	1.65	0.5	1.3	2.98
27240564	39.703348	-80.851624	-0.25	-1.76	0.31	0.81	4.83
27240565	39.703462	-80.85172	-0.42	-2.87	-1.99	-5.15	4.57
27240566	39.704087	-80.851799	0.11	0.77	0.59	1.53	3.9
27240567	39.704218	-80.851766	0.82	5.65	0.85	2.21	3.73
27240568	39.704339	-80.851811	1.09	7.54	-1.06	-2.74	5.37
27240569	39.701623	-80.851214	1.27	8.78	0.02	0.04	5.64
27240570	39.701748	-80.851232	0.78	5.37	0.68	1.76	5
27240571	39.701901	-80.851025	0.15	1.02	0.96	2.49	5.02
27240572	39.702598	-80.851535	0.18	1.23	-0.13	-0.34	5.22
27240573	39.702711	-80.851646	1.04	7.11	2.06	5.35	5.12
27240574	39.703099	-80.851586	0.52	3.55	0.28	0.72	3.86
27240575	39.703213	-80.851689	-0.26	-1.79	-0.31	-0.81	5.23
27240576	39.70348	-80.851584	-0.38	-2.62	-1.36	-3.54	3.58
27240577	39.7036	-80.851633	-0.03	-0.2	-1.08	-2.8	4.62
27240578	39.70189	-80.851116	-0.32	-2.19	1.63	4.22	4.03
27240579	39.702381	-80.851243	1.35	9.34	0.55	1.43	5.79
27240580	39.702498	-80.851322	0.98	6.55	1.26	3.26	4.63
27240581	39.702627	-80.851307	1	6.86	2.29	5.95	5.29
27240582	39.702886	-80.851261	1.15	7.92	2.52	6.55	5.64
27240583	39.703123	-80.851395	0.16	1.13	-0.42	-1.09	4.4
27240584	39.703325	-80.851802	-1.05	-7.27	-1.84	-4.78	4.46
27240585	39.70346	-80.851739	-0.92	-6.37	-1.1	-2.85	4.87
27240586	39.70423	-80.851671	-1.99	-13.76	-2.08	-5.39	6.37
27240587	39.704354	-80.851694	-1.1	-7.48	-1.33	-3.44	5.04
27240588	39.702724	-80.850552	0.29	1.99	1.1	2.85	4.05
27240589	39.702869	-80.850406	0.67	4.6	1.11	2.89	3.51
27240590	39.702985	-80.850493	0.28	1.91	1.6	4.15	3.05
27240591	39.703113	-80.850483	0.22	1.54	1.33	3.46	2.57
27240592	39.703242	-80.850464	0.12	0.81	1.06	2.74	2.46
27240593	39.703367	-80.85048	0.14	0.96	1.08	2.82	2.53
27240594	39.702754	-80.850317	0.72	4.99	0.77	2	3.23
27240595	39.702983	-80.850507	0.39	2.66	1.93	5	3.97

27240596	39.70311	-80.850508	0.4	2.79	1.46	3.79	2.92
27240597	39.70323	-80.850561	0.1	0.67	0.76	1.97	2.55
27240598	39.703356	-80.850572	-0.26	-1.82	0.49	1.26	3.14
27240599	39.703503	-80.85041	-0.09	-0.64	0.84	2.19	4.25
27240600	39.703574	-80.850848	-0.12	-0.85	-1.45	-3.75	3.89
27240601	39.703722	-80.850683	-1.16	-8.02	-2.45	-6.37	5.68
27240602	39.702752	-80.850329	0.29	2.01	-0.67	-1.74	2.91
27240603	39.702884	-80.850289	0.18	1.23	-0.15	-0.39	3.15
27240604	39.70301	-80.850295	0.57	3.83	0.78	2.02	3.58
27240605	39.703121	-80.850423	-0.77	-5.32	-0.14	-0.38	4.66
27240606	39.703265	-80.85029	0.08	0.56	-0.35	-0.92	4.94
27240607	39.703387	-80.850323	0.51	3.52	2.46	6.38	4.44
27240608	39.7035	-80.850434	0.72	4.97	1.19	3.08	5.47
27240609	39.702766	-80.850222	0.03	0.24	-2.07	-5.37	2.6
27240610	39.702883	-80.850297	0.19	1.32	-0.15	-0.38	2.06
27240611	39.703009	-80.850304	0.21	1.43	0.08	0.21	3.03
27240612	39.703116	-80.850465	0.27	1.87	1.12	2.9	2.84
27240613	39.703234	-80.850528	0.34	2.31	0.59	1.52	2.86
27240614	39.703508	-80.850371	-0.05	-0.36	0.3	0.78	2.3
27240615	39.703625	-80.850446	0.06	0.41	-0.36	-0.93	1.77
27240616	39.703739	-80.850551	0.53	3.64	-2.66	-6.9	5.23
27240617	39.703769	-80.849325	-0.09	-0.65	-0.03	-0.08	4.98
27240618	39.703773	-80.849292	0.68	4.72	0.44	1.14	5.15
27240619	39.700126	-80.854978	-0.47	-3.23	-3.61	-9.38	5.17
27240620	39.700119	-80.855032	-0.04	-0.28	-1.53	-3.97	4.41
27240621	39.700257	-80.854945	-0.84	-5.81	-2.63	-6.82	3.86
27240622	39.70013	-80.854944	0.05	0.31	-1.01	-2.63	4.94
27240623	39.700267	-80.854867	-0.93	-6.45	-2.23	-5.79	4.19
27240624	39.700143	-80.854845	-1.7	-11.72	-0.38	-0.98	5.05
27240625	39.700268	-80.85486	-1.69	-11.66	-0.08	-0.21	4.43
27240626	39.700278	-80.854779	-2.18	-15.01	-3.22	-8.37	6.54
27240627	39.700406	-80.854769	-1.14	-7.85	-0.13	-0.34	5.8
27240628	39.700161	-80.8547	0.5	3.38	2.35	6.11	4.34
27240629	39.700283	-80.854742	-0.21	-1.46	0.5	1.29	3.12
27240630	39.700407	-80.854759	-0.98	-6.64	-0.24	-0.63	4.5
27240631	39.700161	-80.854705	-0.51	-3.52	-1.24	-3.22	5.34
27240632	39.700283	-80.854739	-0.67	-4.49	-1.08	-2.81	4.58
27240633	39.701769	-80.851065	1.26	8.18	-0.91	-2.35	4.74
27240634	39.701891	-80.851103	0.79	5.43	0.9	2.33	5.48
27240635	39.702239	-80.851362	0.45	3.11	0.55	1.43	4.95
27240636	39.702382	-80.851236	0.08	0.54	-0.16	-0.43	3.61
27240637	39.702501	-80.851301	0.39	2.66	0.4	1.03	1.75
27240638	39.702627	-80.851304	0.32	2.19	0.11	0.29	1.67
27240639	39.702748	-80.85135	0.04	0.3	-0.7	-1.81	1.76
27240640	39.702873	-80.851371	0.03	0.24	-0.25	-0.66	2.83
27240641	39.703006	-80.851322	1.6	11.07	1.37	3.56	5.66
27240642	39.703103	-80.851557	0.05	0.37	-0.26	-0.67	4.97
27240643	39.703238	-80.851491	0.46	3.16	-0.3	-0.78	5.01
27240644	39.703635	-80.85136	0.14	0.91	1.01	2.62	3.88
27240645	39.703747	-80.851479	-0.03	-0.19	-0.97	-2.53	4.64
27240646	39.704246	-80.851544	-0.33	-2.3	-1.15	-2.97	4.72
27240647	39.704354	-80.851693	-0.55	-3.81	-1.96	-5.09	5.47
27240648	39.704505	-80.851502	0.13	0.92	0.28	0.72	4.85
27240649	39.702136	-80.851175	0.32	2.19	0.63	1.64	3.72
27240650	39.702502	-80.851291	0.42	2.93	0.56	1.46	2.02
27240651	39.70263	-80.851281	0.44	3.03	0.45	1.16	1.57
27240652	39.702757	-80.851279	0.32	2.18	0.13	0.33	1.72

27240653	39.703239	-80.851482	0.22	1.52	-0.01	-0.03	4.45
27240654	39.703366	-80.851482	0.5	3.45	-0.08	-0.2	4.42
27240655	39.703499	-80.851433	-0.05	-0.32	0.47	1.22	4.68
27240656	39.703622	-80.851464	0.27	1.88	0.47	1.21	2.86
27240657	39.703873	-80.851485	-0.27	-1.84	0.07	0.19	5.16
27240658	39.704246	-80.851545	0.79	5.44	2.05	5.32	4.52
27240659	39.70436	-80.851645	-0.39	-2.66	-0.45	-1.18	4.66
27240660	39.704506	-80.851497	-0.09	-0.6	-0.46	-1.2	4.31
27240661	39.701909	-80.850961	-0.12	-0.83	3.02	7.84	4.7
27240662	39.702276	-80.851071	2.76	19.01	3.75	9.73	7.77
27240663	39.702499	-80.851314	0.56	3.78	0.73	1.89	3.59
27240664	39.702636	-80.851234	0.56	3.89	0.61	1.59	1.9
27240665	39.702767	-80.851201	0.8	5.53	0.2	0.51	3.62
27240666	39.70311	-80.851504	0.04	0.26	0.44	1.14	4.91
27240667	39.70324	-80.851472	0.01	0.07	0.57	1.47	4.89
27240668	39.703365	-80.85149	0.16	1.11	0.2	0.51	3.27
27240669	39.703494	-80.851471	0.14	0.95	0.42	1.09	2.57
27240670	39.703624	-80.851447	0.28	1.9	0.48	1.24	2.21
27240671	39.703756	-80.851412	0.98	6.78	0.31	0.81	4.31
27240672	39.703881	-80.851422	0.09	0.59	0.63	1.62	4.88
27240673	39.704001	-80.851477	0.54	3.71	0.98	2.54	5.34
27240674	39.704384	-80.851461	-0.76	-5.22	-0.81	-2.11	4.83
27240675	39.702017	-80.851117	-0.01	-0.06	0.16	0.42	2.81
27240676	39.702137	-80.851167	0.22	1.48	0.16	0.41	3.78
27240677	39.702264	-80.85117	0.53	3.63	0.47	1.23	4.86
27240678	39.702517	-80.851177	0.49	3.32	1.08	2.8	3.49
27240679	39.702647	-80.851149	1.38	9.54	1.24	3.22	4.26
27240680	39.702768	-80.8512	0.53	3.38	-1.07	-2.77	3.36
27240681	39.703002	-80.85135	0.31	2.16	0.68	1.76	3.62
27240682	39.703134	-80.85131	0.58	4.02	0.96	2.48	2.63
27240683	39.703243	-80.85145	-0.17	-1.18	-0.57	-1.49	4.68
27240684	39.70338	-80.851376	0.19	1.31	0.87	2.25	2.61
27240685	39.703504	-80.851394	0.24	1.63	0.57	1.49	2.33
27240686	39.70363	-80.851402	0.28	1.95	0.51	1.32	2.21
27240687	39.703751	-80.851447	0.32	2.1	-0.86	-2.24	3.62
27240688	39.703883	-80.851406	0.59	4.1	2.02	5.24	4.9
27240689	39.704013	-80.851387	0.09	0.64	-0.43	-1.11	5.19
27240690	39.704142	-80.851369	0.91	6.3	1.15	2.98	4.71
27240691	39.704264	-80.851405	0.88	5.89	-0.11	-0.29	4.13
27240692	39.703603	-80.849633	0.47	3.06	-2.66	-6.89	4.37
27240693	39.703714	-80.849758	1.75	12.09	0.95	2.47	4.66
27240694	39.703833	-80.849818	1.88	12.93	0.15	0.39	5.2
27240695	39.7036	-80.849653	0.49	3.18	-2.81	-7.3	4.37
27240696	39.703715	-80.849747	1.63	11.24	0.59	1.54	4.46
27240697	39.703839	-80.84977	1.81	12.45	0.46	1.18	4.88
27240698	39.703478	-80.849615	2.16	14.85	1.53	3.97	5.51
27240699	39.703737	-80.849575	0.55	3.8	0.14	0.36	4.5
27240700	39.703478	-80.849615	1.81	12.48	0.73	1.9	5.46
27240701	39.703747	-80.849494	0.55	3.77	-1.72	-4.47	4.79
27240702	39.702386	-80.854174	-0.6	-4.12	-1.06	-2.75	4.88
27240703	39.702255	-80.854207	-0.34	-2.36	-0.71	-1.85	3.42
27240704	39.70238	-80.854221	-0.32	-2.24	-0.72	-1.88	2.87
27240705	39.702505	-80.854241	-0.12	-0.8	-0.89	-2.3	4.5
27240706	39.702629	-80.854259	0.46	3.2	1.51	3.93	5.19
27240707	39.700277	-80.853794	-0.35	-2.41	1.1	2.87	5.07
27240708	39.700769	-80.853916	0.55	3.77	-0.95	-2.47	5.29
27240709	39.702255	-80.854206	-0.17	-1.18	-0.42	-1.08	2.1

27240710	39.702383	-80.854197	-0.17	-1.21	-0.28	-0.73	2.4
27240711	39.70251	-80.854198	-0.24	-1.65	0.11	0.29	3.2
27240712	39.700174	-80.853607	-0.2	-1.39	1.66	4.3	4.75
27240713	39.700294	-80.853666	-0.1	-0.68	2.82	7.32	5.21
27240714	39.70077	-80.853911	-0.16	-1.14	-0.08	-0.21	5.17
27240715	39.70152	-80.853997	2.42	16.59	0.58	1.51	6.37
27240716	39.701652	-80.853964	0.2	1.35	-0.59	-1.52	5.26
27240717	39.702258	-80.854182	-0.46	-3.15	-0.21	-0.55	2.52
27240718	39.702387	-80.854169	-0.44	-3.02	-0.53	-1.37	2.66
27240719	39.702512	-80.854183	-0.35	-2.43	-0.56	-1.46	3.29
27240720	39.700766	-80.853945	0.02	0.16	-1.04	-2.7	4.86
27240721	39.701649	-80.853984	0.18	1.28	0.27	0.71	3.96
27240722	39.701772	-80.854019	0.51	3.54	-0.05	-0.14	4.67
27240723	39.702389	-80.854152	-0.66	-4.58	-1.4	-3.62	3.66
27240724	39.702514	-80.854167	-0.31	-2.13	-0.96	-2.49	3.47
27240725	39.702644	-80.854142	0.37	2.57	-0.22	-0.57	4.68
27240726	39.70414	-80.854355	-1.27	-8.76	-0.75	-1.96	5.8
27240727	39.700048	-80.853602	-0.17	-1.15	0.3	0.78	4.22
27240728	39.701525	-80.853962	1.07	7.4	-0.42	-1.09	5.44
27240729	39.701653	-80.853951	0.39	2.7	-0.72	-1.87	3.67
27240730	39.70178	-80.853955	0.24	1.64	-0.58	-1.5	3.62
27240731	39.701906	-80.853959	-0.03	-0.23	-0.15	-0.4	4.79
27240732	39.702397	-80.85409	0.3	2.09	0.53	1.37	4.49
27240733	39.702522	-80.854106	0.18	1.27	-0.14	-0.38	4.27
27240734	39.702283	-80.853991	0.28	1.95	0.16	0.42	3.33
27240735	39.702407	-80.854014	0.48	3.32	1.02	2.66	2.98
27240736	39.702532	-80.854024	0.76	5.23	3.79	9.84	5.02
27240737	39.701546	-80.853797	-0.93	-6.39	-2.48	-6.44	4.71
27240738	39.701662	-80.853885	-0.79	-5.46	-1.21	-3.13	4.79
27240739	39.702289	-80.853943	-0.1	-0.7	0.25	0.65	3.82
27240740	39.702407	-80.854009	0.2	1.36	-0.04	-0.1	3.97
27240741	39.702455	-80.850669	-0.14	-0.96	1.41	3.65	4.26
27240742	39.70283	-80.85071	-0.21	-1.44	1.28	3.32	4.5
27240743	39.702961	-80.850676	0.08	0.54	-0.01	-0.03	3.23
27240744	39.703074	-80.850787	0.13	0.92	0.84	2.19	3.45
27240745	39.703201	-80.850789	0.13	0.91	1.34	3.48	3.4
27240746	39.703329	-80.850783	0.14	0.95	1.59	4.13	3.08
27240747	39.703454	-80.850797	0.53	3.63	1.26	3.27	3.41
27240748	39.703828	-80.850846	-0.15	-1.06	0.37	0.95	5.12
27240749	39.702471	-80.850544	0.63	4.33	0.43	1.13	5.19
27240750	39.702716	-80.850613	-0.26	-1.82	-0.64	-1.65	2.99
27240751	39.702855	-80.850515	2.09	14.41	2.62	6.81	6.39
27240752	39.702958	-80.8507	0.24	1.63	1.27	3.3	3.88
27240753	39.703084	-80.850712	0.42	2.92	0.5	1.3	3.05
27240754	39.703202	-80.85078	0.09	0.64	1.07	2.77	3.32
27240755	39.703338	-80.850708	0.38	2.6	1.81	4.71	3.32
27240756	39.70246	-80.850626	0.97	6.49	0.21	0.55	3.35
27240757	39.702579	-80.850687	0.69	4.74	0.61	1.59	2.77
27240758	39.702709	-80.850663	0.63	4.32	1.99	5.18	5.16
27240759	39.703081	-80.850734	0.63	4.3	1.98	5.14	3.77
27240760	39.703208	-80.850732	0.61	4.11	1.56	4.05	3.21
27240761	39.703325	-80.850813	0.42	2.89	1.84	4.78	4.44
27240762	39.703452	-80.850808	-0.02	-0.13	1.62	4.21	4.1
27240763	39.70359	-80.850725	-0.1	-0.71	0.21	0.55	3.15
27240764	39.703698	-80.850873	0.24	1.68	0.83	2.16	4.17
27240765	39.702602	-80.850511	0.69	4.75	0.42	1.09	3.37
27240766	39.702731	-80.85049	0.77	5.31	0.17	0.43	3.38

27240767	39.702859	-80.850487	0.95	6.55	-1.18	-3.06	5.08
27240768	39.703073	-80.850798	0.41	2.82	0.18	0.47	4.17
27240769	39.703232	-80.850548	0.45	3.1	1.24	3.21	2.82
27240770	39.703347	-80.850637	0.29	2.03	0.77	2.01	3.01
27240771	39.70348	-80.850587	0.46	3.03	0.83	2.14	3.42
27240772	39.703601	-80.85064	-0.27	-1.84	0.24	0.62	2.58
27240773	39.703724	-80.850669	-0.36	-2.49	0.17	0.44	3.22
27240774	39.70261	-80.850445	-0.1	-0.67	-0.05	-0.14	4.32
27240775	39.702733	-80.850476	0.72	4.95	0.59	1.53	3.04
27240776	39.702854	-80.850523	0.9	6.2	0.96	2.49	3.02
27240777	39.703102	-80.850567	-0.52	-3.61	-1.31	-3.39	3.95
27240778	39.703229	-80.850571	0.2	1.36	0.78	2.03	2.61
27240779	39.70335	-80.850613	0.2	1.36	0.77	1.99	2.74
27240780	39.703469	-80.85068	0.63	4.32	0.96	2.48	3.15
27240781	39.703598	-80.850664	-0.1	-0.7	0.97	2.52	2.56
27240782	39.703726	-80.850655	-0.17	-1.2	-0.26	-0.66	3.93
27240783	39.700362	-80.857096	0.58	4.01	-0.1	-0.26	4.93
27240784	39.700249	-80.856987	-0.35	-2.43	-2.24	-5.81	4.88
27240785	39.700375	-80.856993	0.97	6.62	-0.38	-1	2.65
27240786	39.700501	-80.857003	1.32	9.06	0.05	0.13	3.81
27240787	39.700381	-80.856943	0.02	0.16	-0.46	-1.19	4.72
27240788	39.700516	-80.856881	0.48	3.33	-0.78	-2.01	5.24
27240789	39.70029	-80.856667	-0.82	-5.69	-2.22	-5.77	5.08
27240790	39.700285	-80.856701	-0.43	-2.97	-1.5	-3.89	4.68
27240791	39.700286	-80.855704	0.2	1.37	-1.54	-3.99	5.03
27240792	39.700191	-80.855456	0.17	1.15	-1.06	-2.75	4.9
27240793	39.700299	-80.855604	0.16	1.1	-1.41	-3.67	4.93
27240794	39.703418	-80.855033	-0.71	-4.88	-0.99	-2.57	4.85
27240795	39.700165	-80.85467	0.03	0.19	0.67	1.73	5.17
27240796	39.700302	-80.854594	0.06	0.43	-0.57	-1.48	4.71
27240797	39.700381	-80.856941	0.25	1.71	-1.68	-4.37	4.66
27240798	39.700488	-80.857097	-0.13	-0.91	0.74	1.93	3.88
27240799	39.700622	-80.857048	0.87	6.03	0.98	2.54	5.11
27240800	39.700195	-80.856419	2.62	18.09	0.6	1.56	7.77
27240801	39.700082	-80.856308	1.44	9.97	2.04	5.3	5.81
27240802	39.700198	-80.856389	0.68	4.68	1.96	5.1	5.47
27240803	39.701541	-80.856812	0.61	4.24	-0.53	-1.39	5.25
27240804	39.701693	-80.85661	0.83	5.76	0.73	1.89	5.32
27240805	39.700132	-80.852949	0.72	4.98	1.41	3.66	2.64
27240806	39.700247	-80.853043	0.52	3.43	1.03	2.68	2.48
27240807	39.70059	-80.853333	-0.53	-3.6	0.44	1.15	4.01
27240808	39.700724	-80.85328	0.1	0.68	0.33	0.85	3.24
27240809	39.700866	-80.853163	0.38	2.62	1.15	2.98	5.2
27240810	39.702352	-80.853453	0.48	3.31	0.72	1.86	4.38
27240811	39.702461	-80.853594	0.53	3.66	1.3	3.36	5.22
27240812	39.70296	-80.853656	0.07	0.52	0.99	2.56	4.92
27240813	39.703078	-80.853726	-1.1	-7.53	-4.22	-10.95	4.58
27240814	39.703205	-80.853731	-1.48	-10.09	-3.67	-9.53	5.25
27240815	39.70014	-80.852883	0.53	3.65	1.14	2.95	3.03
27240816	39.700243	-80.853074	0.4	2.72	0.36	0.95	4.52
27240817	39.702961	-80.853651	0.62	4.29	1.68	4.36	5.29
27240818	39.703082	-80.8537	-1.65	-11.3	-3.88	-10.08	5.38
27240819	39.703211	-80.853684	-2.28	-15.53	-3.17	-8.22	6.5
27240820	39.704606	-80.853684	-2.49	-17.18	-1.24	-3.22	7.28
27240821	39.702359	-80.853393	0.92	6.25	0.17	0.43	4.41
27240822	39.702491	-80.85336	0.73	5.02	0.78	2.03	5.24
27240823	39.702969	-80.853592	0.5	3.34	0.61	1.59	4.22

27240824	39.700154	-80.852778	-0.33	-2.27	-0.1	-0.26	5.12
27240825	39.702361	-80.853379	0.88	6.08	0.48	1.24	5.3
27240826	39.702725	-80.853511	0.11	0.76	0.26	0.68	4.73
27240827	39.700282	-80.85277	0	-0.01	0.33	0.84	3.46
27240828	39.702615	-80.853377	-1.27	-8.74	1	2.59	5.68
27240829	39.703127	-80.853345	0.38	2.64	0.48	1.25	5.19
27240830	39.700274	-80.852828	0.31	2.12	-1.83	-4.76	2.92
27240831	39.700396	-80.852866	0.17	1.2	-2.35	-6.11	4.71
27240832	39.702746	-80.853351	0.22	1.53	-1.23	-3.19	5.37
27240833	39.700279	-80.852794	0.1	0.66	-2.03	-5.28	5.46
27240834	39.702625	-80.853302	-0.24	-1.68	-3.24	-8.4	4.53
27240835	39.702748	-80.85333	0.18	1.22	-1.67	-4.34	4.47
27240836	39.702877	-80.853317	0.43	2.97	1.56	4.05	4.79
27240837	39.703117	-80.853425	-0.57	-3.91	0.2	0.52	5.18
27240838	39.700285	-80.852744	-0.42	-2.88	-1.01	-2.63	4.83
27240839	39.700403	-80.85281	0.48	3.32	-1.89	-4.9	5.16
27240840	39.701767	-80.853063	-0.03	-0.14	-1.07	-2.78	2.92
27240841	39.702251	-80.853249	0.65	4.48	1.42	3.68	5.22
27240842	39.70263	-80.853265	-0.25	-1.7	-0.7	-1.81	4.88
27240843	39.70288	-80.853293	0.53	3.62	0.98	2.54	4.8
27240844	39.703111	-80.853473	-1.37	-9.44	0	0	5.69
27240845	39.703241	-80.853445	-0.69	-4.78	0.25	0.65	4.76
27240846	39.703363	-80.853488	-0.07	-0.51	1.32	3.43	3.94
27240847	39.703496	-80.853438	-0.1	-0.64	2.3	5.97	3.74
27240848	39.703626	-80.853415	-0.15	-1.01	-1.09	-2.82	4.78
27240849	39.701318	-80.851613	0.04	0.3	0.25	0.65	1.63
27240850	39.701447	-80.851601	0.06	0.43	0.46	1.18	2.1
27240851	39.701573	-80.851606	0.19	1.32	0.53	1.36	3.04
27240852	39.701694	-80.851656	-0.14	-0.98	0.44	1.13	4.46
27240853	39.703163	-80.852078	0.06	0.4	0.34	0.89	3.04
27240854	39.703298	-80.852009	-0.09	-0.6	0.31	0.81	2.62
27240855	39.703907	-80.85221	0.05	0.36	-1.94	-5.04	5.05
27240856	39.704284	-80.852242	1.18	8.13	1.12	2.91	4.93
27240857	39.701197	-80.851572	1.21	8.28	-0.25	-0.65	3.77
27240858	39.701319	-80.851608	0.49	3.36	-0.12	-0.32	2.51
27240859	39.701445	-80.851614	0.62	4.27	-0.09	-0.23	2.76
27240860	39.701566	-80.851664	1.52	10.45	-0.13	-0.33	3.36
27240861	39.70169	-80.851684	1.75	11.98	0.09	0.23	3.67
27240862	39.70245	-80.851694	0.77	5.32	1.22	3.15	4.72
27240863	39.703302	-80.851981	0.7	4.8	-0.23	-0.59	4.31
27240864	39.703438	-80.851905	0.85	5.87	-0.73	-1.89	4.82
27240865	39.704156	-80.852249	-0.04	-0.28	-0.36	-0.93	5.26
27240866	39.704273	-80.852331	0.26	1.81	-0.23	-0.6	5.16
27240867	39.70132	-80.851597	0.69	4.74	-0.28	-0.71	2.7
27240868	39.701447	-80.8516	0.78	5.41	-0.19	-0.48	2.91
27240869	39.701567	-80.851657	1.62	11.1	-0.19	-0.5	3.47
27240870	39.7017	-80.851608	0.73	5.04	0.18	0.47	2.97
27240871	39.702212	-80.851574	0.88	6.05	0.49	1.28	5.13
27240872	39.702454	-80.851667	0.95	6.56	1.89	4.92	5.24
27240873	39.702576	-80.851705	1.1	7.62	1.13	2.93	5.17
27240874	39.703181	-80.851934	-0.19	-1.28	-0.2	-0.53	4.66
27240875	39.703428	-80.851986	0.18	1.21	-0.63	-1.62	4.38
27240876	39.70355	-80.852026	0.6	4.12	-1.14	-2.97	4.02
27240877	39.701321	-80.85159	0.84	5.79	-0.42	-1.09	3.13
27240878	39.701442	-80.851639	1.5	10.32	-0.82	-2.12	3.68
27240879	39.701569	-80.851642	1.7	11.68	-0.68	-1.78	3.92
27240880	39.701951	-80.851628	0.9	6.19	0.7	1.81	4.8

27240881	39.702355	-80.851444	1	6.9	1.04	2.69	5.46
27240882	39.702817	-80.851807	0.36	2.5	-0.46	-1.2	5.26
27240883	39.702951	-80.851746	-0.5	-3.46	-0.51	-1.33	4.8
27240884	39.703056	-80.851918	-0.05	-0.34	0.86	2.22	4.51
27240885	39.703179	-80.851947	-0.1	-0.72	-0.26	-0.66	2.3
27240886	39.703304	-80.851966	-0.1	-0.66	0.16	0.41	1.78
27240887	39.703427	-80.851994	-0.07	-0.47	0.44	1.15	1.68
27240888	39.703551	-80.852016	0.22	1.51	0.47	1.23	3.81
27240889	39.702282	-80.851025	-0.05	-0.36	0.9	2.35	4.48
27240890	39.702405	-80.851058	0.33	2.28	1.2	3.11	4.13
27240891	39.702531	-80.851063	0.47	3.22	1.22	3.17	3.89
27240892	39.702653	-80.851101	0.52	3.57	1.27	3.31	4.26
27240893	39.70279	-80.851023	0.58	4.02	1.15	2.97	4.4
27240894	39.702912	-80.851067	0.67	4.64	1.1	2.86	3.45
27240895	39.703051	-80.850967	0.92	6.37	1.12	2.91	4.39
27240896	39.703166	-80.851063	0.67	4.59	1.33	3.44	4.8
27240897	39.703306	-80.850957	0.54	3.7	1.81	4.7	5.29
27240898	39.70392	-80.851121	0.9	6.2	0.85	2.2	5.49
27240899	39.704266	-80.851395	0.13	0.9	0.84	2.18	4.37
27240900	39.704397	-80.851357	-0.71	-4.91	1.15	2.98	4.69
27240901	39.702192	-80.850738	1.96	13.52	3.47	9.01	4.53
27240902	39.702323	-80.850705	2.19	15.04	2.09	5.41	6.32
27240903	39.703033	-80.851113	1.19	8.19	1.98	5.13	4.63
27240904	39.703413	-80.851118	0.14	0.94	-0.33	-0.85	4.84
27240905	39.703662	-80.851153	-1.36	-9.4	0.6	1.55	5.72
27240906	39.703793	-80.851123	-1.63	-11.25	-0.23	-0.6	6.04
27240907	39.704273	-80.851335	-0.53	-3.64	-1.56	-4.04	4.75
27240908	39.704406	-80.851287	-0.63	-4.33	-0.08	-0.21	4.47
27240909	39.702186	-80.850786	1	6.87	1.46	3.78	2.81
27240910	39.702308	-80.850828	1.71	11.78	1.61	4.18	3.79
27240911	39.702565	-80.850795	0.54	3.68	0.3	0.78	4.11
27240912	39.702684	-80.850859	1.29	8.39	1.83	4.75	4.37
27240913	39.703066	-80.85085	1.17	8.08	2.23	5.78	4.89
27240914	39.703391	-80.851293	0.2	1.35	-0.03	-0.07	4.31
27240915	39.703676	-80.851046	-1.44	-9.92	-4.16	-10.78	5.8
27240916	39.70219	-80.850758	1	6.87	1.23	3.18	3.08
27240917	39.702308	-80.850822	1.79	12.34	1.54	4	3.79
27240918	39.702541	-80.85099	0.78	5.38	0.98	2.54	4.16
27240919	39.702678	-80.85091	0.9	6.23	1.4	3.63	4.64
27240920	39.702924	-80.850966	0.81	5.45	1.56	4.06	3.76
27240921	39.703197	-80.850816	0.25	1.7	1	2.6	4.05
27240922	39.70331	-80.850927	0.2	1.37	0.66	1.7	3.69
27240923	39.703414	-80.851104	-0.51	-3.51	0.16	0.42	4.44
27240924	39.703791	-80.851141	0.39	2.68	-0.94	-2.43	4.85
27240925	39.703246	-80.85044	0.06	0.39	0.62	1.61	5.33
27240926	39.703524	-80.850247	0.5	3.46	0.21	0.54	2.13
27240927	39.703653	-80.850235	0.25	1.74	0.31	0.81	1.78
27240928	39.703775	-80.850274	-0.03	-0.19	1.12	2.9	3.58
27240929	39.702896	-80.850199	-0.48	-3.32	0.36	0.95	5.35
27240930	39.703555	-80.850002	0.17	1.2	2.54	6.59	3.84
27240931	39.703697	-80.849887	0.1	0.67	2.84	7.38	4.65
27240932	39.703517	-80.850302	-0.62	-4.26	1.85	4.81	5.17
27240933	39.703782	-80.849225	0.26	1.82	-0.73	-1.91	4.43
27240934	39.703904	-80.84926	0.55	3.82	0.85	2.19	5.22
27240935	39.703795	-80.849124	0.03	0.17	-0.17	-0.44	4.17
27240936	39.700095	-80.855215	-1.27	-8.75	-2.15	-5.58	5.36
27240937	39.700226	-80.855181	-1.07	-7.38	-2.58	-6.7	5.07

27240938	39.702951	-80.855709	-0.1	-0.7	-0.69	-1.79	5.14
27240939	39.700501	-80.855018	0.43	2.94	2.39	6.19	5.01
27240940	39.700106	-80.855131	-1.35	-9.32	-2.39	-6.2	5.2
27240941	39.700232	-80.855141	-1.64	-11.32	-1.95	-5.06	5.81
27240942	39.700503	-80.855	0.44	3.05	2.71	7.04	5.18
27240943	39.700101	-80.855169	-1.41	-9.73	1.03	2.66	5.68
27240944	39.700228	-80.855169	-1.71	-11.82	-0.39	-1.01	4.81
27240945	39.700365	-80.855088	-1.48	-10.19	-0.46	-1.19	5.37
27240946	39.701672	-80.853808	-0.3	-2.09	-2.72	-7.05	5.2
27240947	39.701936	-80.853729	-0.07	-0.48	-0.3	-0.79	4.19
27240948	39.702063	-80.853727	-0.4	-2.76	-0.01	-0.04	3.81
27240949	39.699949	-80.853387	0.88	6.09	1.34	3.47	5.51
27240950	39.701938	-80.853713	-0.11	-0.75	0.22	0.58	3.69
27240951	39.702063	-80.853726	-0.21	-1.45	0.23	0.6	3.86
27240952	39.70194	-80.853697	-0.78	-5.39	0.91	2.37	5.37
27240953	39.702671	-80.853937	-0.21	-1.43	-1.19	-3.09	4.8
27240954	39.701204	-80.853499	-2.05	-14.11	-1.09	-2.83	6.77
27240955	39.701338	-80.853437	-1.34	-9.28	-0.95	-2.46	5.7
27240956	39.702182	-80.85379	1.55	10.71	0.86	2.24	3.36
27240957	39.702686	-80.85382	0.08	0.57	-0.5	-1.29	3.65
27240958	39.702811	-80.853834	0.33	2.25	-0.44	-1.15	4.96
27240959	39.701342	-80.853408	-1.36	-9.36	-0.21	-0.55	5.54
27240960	39.701949	-80.853623	-0.69	-4.78	0.48	1.24	4.84
27240961	39.7022	-80.853644	0.5	3.48	0.27	0.7	2.94
27240962	39.702328	-80.853636	0.52	3.52	0.54	1.39	4.34
27240963	39.700116	-80.85307	-0.19	-1.34	-1.1	-2.84	4.69
27240964	39.700234	-80.853141	0.83	5.72	0.35	0.91	5.42
27240965	39.701219	-80.853382	-1.75	-10.14	-1.28	-3.32	5.62
27240966	39.701344	-80.853394	-1.92	-11.11	-1.7	-4.42	5.82
27240967	39.702201	-80.853643	0.12	0.85	-0.94	-2.45	4.25
27240968	39.702313	-80.853757	0.01	0.08	0.52	1.34	5.21
27240969	39.703075	-80.853753	0.27	1.87	1.49	3.87	4.79
27240970	39.702823	-80.853736	0.2	1.39	0.24	0.62	4.82
27240971	39.700238	-80.853109	0.49	3.14	0.37	0.95	4.5
27240972	39.700591	-80.853327	-0.13	-0.9	-0.16	-0.42	3.88
27240973	39.700723	-80.853288	-0.01	-0.06	0.34	0.88	3.7
27240974	39.701081	-80.851485	1.03	7.1	1.36	3.52	5.69
27240975	39.701158	-80.851875	0.15	1.07	-0.74	-1.93	3.45
27240976	39.701292	-80.851822	0.33	2.26	-1.13	-2.94	2.55
27240977	39.701417	-80.851837	0.51	3.55	-0.57	-1.47	2.14
27240978	39.701545	-80.851826	0.7	4.82	0.02	0.05	2.2
27240979	39.701673	-80.851818	1.33	9.04	1.33	3.46	4.71
27240980	39.702019	-80.852093	0.26	1.79	-0.38	-0.98	5.08
27240981	39.70217	-80.851899	0.83	5.71	-0.59	-1.52	5.31
27240982	39.702414	-80.851973	0.78	5.36	-0.67	-1.75	5.2
27240983	39.702775	-80.852135	0.1	0.7	1.06	2.76	4.49
27240984	39.702896	-80.852175	0.67	4.57	-0.39	-1.02	4.37
27240985	39.703012	-80.852265	0.73	5.05	-1.32	-3.44	5.05
27240986	39.703127	-80.85236	0.11	0.73	0.17	0.45	5.1
27240987	39.7034	-80.852204	-0.96	-6.61	-0.2	-0.52	5.01
27240988	39.703877	-80.852446	-0.65	-4.51	-1.05	-2.73	4.94
27240989	39.70401	-80.8524	-1.2	-8.28	-1.94	-5.05	5.13
27240990	39.704121	-80.852524	-1.03	-7.11	-1.25	-3.23	5.07
27240991	39.70107	-80.851572	0.7	4.86	1.23	3.18	5.16
27240992	39.701296	-80.851787	1.46	9.86	1.4	3.64	4.63
27240993	39.701414	-80.851856	0.89	4.54	-1.92	-4.99	3.89
27240994	39.70178	-80.851973	0.7	4.79	-1.18	-3.07	3.94

27240995	39.701905	-80.85199	0.92	6.29	-1.91	-4.96	4.79
27240996	39.703285	-80.85211	-0.13	-0.92	0.57	1.49	5.26
27240997	39.703408	-80.852145	0.02	0.13	-0.56	-1.45	4.24
27240998	39.701057	-80.851674	0.52	3.57	-0.88	-2.29	4.6
27240999	39.701186	-80.851659	-1.54	-10.61	-1.07	-2.77	5.83
27241000	39.701309	-80.851685	1.88	12.98	1.99	5.15	5.72
27241001	39.701795	-80.851857	0.38	2.6	0.09	0.23	3.22
27241002	39.70192	-80.851871	0.33	2.26	-0.08	-0.2	3.41
27241003	39.703283	-80.852128	1.02	7.07	0.62	1.62	5.11
27241004	39.704014	-80.852371	-0.74	-5.09	-3.33	-8.63	4.78
27241005	39.701309	-80.851686	0.7	4.79	-1.87	-4.85	3.52
27241006	39.701434	-80.851698	1.31	9.01	0.14	0.37	4.04
27241007	39.701563	-80.85168	1.63	11.18	0.08	0.2	4.56
27241008	39.702051	-80.851838	0.39	2.72	0.98	2.55	5.22
27241009	39.702771	-80.852168	-0.3	-2.04	0.05	0.12	5.34
27241010	39.703289	-80.85208	0.76	5.15	0.66	1.71	4.02
27241011	39.703419	-80.852054	0.96	6.39	1.56	4.05	4.86
27241012	39.703755	-80.852406	-0.49	-3.39	-2	-5.19	4.61
27241013	39.704025	-80.852283	-0.22	-1.49	-1.26	-3.28	4.03
27241014	39.704138	-80.852388	-0.53	-3.6	-1.82	-4.73	4.47
27241015	39.704268	-80.852366	-0.35	-2.42	-1.09	-2.82	5.11
27241016	39.701215	-80.851429	-1.27	-8.77	-1.41	-3.65	5.55
27241017	39.701321	-80.851593	0.64	4.42	1.64	4.25	3.55
27241018	39.701445	-80.851617	0.36	2.48	0.05	0.12	3.25
27241019	39.701578	-80.85157	0.55	3.77	0.07	0.18	4.04
27241020	39.70168	-80.851761	0.27	1.85	-0.5	-1.31	5.16
27241021	39.701791	-80.851892	0.79	5.44	0.31	0.81	4.9
27241022	39.701924	-80.851842	0.26	1.81	0.8	2.08	5.15
27241023	39.703903	-80.852241	0.09	0.65	-1.04	-2.71	5.22
27241024	39.704006	-80.852428	-0.27	-1.84	-0.27	-0.71	4.59
27241025	39.704134	-80.852425	-1.04	-7.02	-0.48	-1.24	4.76
27241026	39.701768	-80.851077	0.45	3.11	1.47	3.81	4.29
27241027	39.702498	-80.851322	0.14	0.95	1.3	3.36	3.16
27241028	39.702621	-80.851354	0.23	1.57	1.41	3.66	4.34
27241029	39.703087	-80.851681	0.71	4.9	-0.3	-0.79	5.06
27241030	39.70323	-80.851555	0.18	1.23	-0.2	-0.51	3.88
27241031	39.703361	-80.851523	0.25	1.72	2.09	5.43	5.19
27241032	39.703487	-80.851528	0.2	1.36	3.75	9.73	5.2
27241033	39.703613	-80.85153	0.7	4.84	2.65	6.87	4.83
27241034	39.70436	-80.851649	-0.53	-3.63	-0.91	-2.36	4.99
27241035	39.701765	-80.851095	1.97	13.55	0.37	0.97	4.07
27241036	39.702147	-80.851086	1.03	7.1	-0.41	-1.06	5.15
27241037	39.702272	-80.851104	0.27	1.83	0.37	0.95	4.38
27241038	39.702368	-80.851345	0.12	0.86	-0.21	-0.56	3.37
27241039	39.702743	-80.851388	0.83	5.75	1.59	4.12	3.95
27241040	39.702867	-80.851412	0.82	5.67	1.4	3.63	3.36
27241041	39.70311	-80.851502	0.57	3.91	-0.1	-0.25	4.96
27241042	39.701771	-80.85105	0.85	5.54	-1.34	-3.47	2.86
27241043	39.701893	-80.851089	1.26	8.71	1.07	2.78	4.23
27241044	39.702024	-80.851057	1.14	7.84	1.28	3.32	5.56
27241045	39.702622	-80.851341	-0.34	-2.29	-1.28	-3.33	3.37
27241046	39.702748	-80.851355	-0.11	-0.75	-0.36	-0.94	2.36
27241047	39.70287	-80.851391	0.59	4.09	0.5	1.3	3.17
27241048	39.702989	-80.851451	0.96	6.63	0.86	2.24	4.67
27241049	39.703483	-80.851558	-0.73	-5.03	-1.55	-4.03	5.87
27241050	39.70449	-80.851623	-0.25	-1.74	0.37	0.95	5.23
27241051	39.703728	-80.849643	0.57	3.92	0.64	1.66	5.35

27241052	39.703946	-80.849925	-1.18	-8.13	-1	-2.61	5.07
27241053	39.701253	-80.852124	0.79	5.34	1.1	2.86	4.79
27241054	39.701237	-80.852247	-1.03	-7.14	0.1	0.26	4.42
27241055	39.701115	-80.852206	-7.76	-53.45	-0.31	-0.79	17.18
27241056	39.701238	-80.852244	-3.59	-24.71	-0.22	-0.58	7.6
27241057	39.701125	-80.852131	-3.25	-22.41	-0.08	-0.22	10.72
27241058	39.701244	-80.852195	-7.18	-49.48	-0.14	-0.36	16.7
27241059	39.702191	-80.854706	0.14	0.71	0.16	0.41	4.28
27241060	39.701777	-80.852983	0.32	1.55	-0.41	-1.07	3.31
27241061	39.70155	-80.852773	-2.23	-2.94	0	0	3.2
27241062	39.701799	-80.852813	-0.89	-0.32	0	0	0.71
27241063	39.701803	-80.852786	-0.6	-0.22	0	0	0.71
27241064	39.701807	-80.852749	0.01	0	0	0	0.81
27241065	39.701215	-80.851426	1.9	13.1	4.29	11.14	5.88
27241066	39.702384	-80.851224	2.04	13.75	2.61	6.79	6.06
27241067	39.703519	-80.851279	0.85	5.68	-3.44	-8.94	4.51
27241068	39.701759	-80.853129	-0.45	-2.16	-1.58	-4.1	4.22
27241069	39.701971	-80.85147	1.98	13.66	1.53	3.97	6.34
27241070	39.701425	-80.851775	1.71	11.76	0.52	1.34	5.54
27241071	39.702652	-80.852102	-1.32	-0.61	0	0	2.06
27241072	39.702775	-80.852129	-1.27	-0.58	0	0	2.21
27241073	39.701214	-80.851435	3.39	23.33	3.14	8.15	8.56
27241074	39.702611	-80.85044	0.21	1.39	0.24	0.64	3.87
27241075	39.702978	-80.850548	2.99	18.97	1.81	4.71	4.91
27241076	39.701403	-80.853925	2.51	16.64	1.1	2.85	6.43
27241077	39.701648	-80.852011	1.42	9.12	1.08	2.81	4.83
27241078	39.704255	-80.851476	1.44	9.76	0.87	2.25	4.79
27241079	39.703139	-80.850284	0.61	4.1	2.2	5.71	4.89
27241080	39.702342	-80.853528	2.25	15.45	0.26	0.66	6.74
27241081	39.701612	-80.852298	-2.72	-18.77	-1.12	-2.91	6.56
27241082	39.700559	-80.857534	0.36	2.49	0.73	1.88	5.44
27241083	39.70384	-80.849766	1.55	10.71	0.13	0.35	5.27
27241084	39.703606	-80.849608	2.01	13.83	1.23	3.18	6.15
27241085	39.703479	-80.849607	1.81	12.45	0.71	1.84	6.02
27241086	39.703613	-80.849553	2.01	13.85	0.93	2.41	6.86
27241087	39.704612	-80.852654	-6.75	-46.54	0.33	0.86	13.81
27241088	39.701161	-80.856797	0.05	0.35	-0.8	-2.06	3.7
27241089	39.702642	-80.85515	-3.18	-21.92	-1.84	-4.79	4.92
27241090	39.702649	-80.855098	-2.85	-19.68	-1.2	-3.11	4.98
27241091	39.702661	-80.855001	-2.81	-19.36	-1.36	-3.54	3.96
27241092	39.702665	-80.854969	-3.03	-20.91	-1.43	-3.72	4.3
27241093	39.702673	-80.854909	-3.04	-20.95	-1.7	-4.4	3.78
27241094	39.702931	-80.854872	-3.54	-24.4	-2.98	-7.72	4.64
27241095	39.702936	-80.854832	-3	-20.67	-1.41	-3.67	4.4
27241096	39.700929	-80.856631	0.31	2.16	0.31	0.8	3.48
27241097	39.701053	-80.856653	-0.08	-0.59	-0.29	-0.75	4.46
27241098	39.700933	-80.856603	0.06	0.39	-0.28	-0.72	3.58
27241099	39.701058	-80.856614	0.1	0.66	-0.36	-0.93	3.82
27241100	39.701176	-80.856684	-5.2	-35.84	-4.1	-10.63	5.35
27241101	39.700937	-80.856567	-0.17	-1.18	-1.29	-3.34	3.68
27241102	39.701061	-80.856593	0.57	3.94	0.3	0.78	4.33
27241103	39.701431	-80.856675	-4.88	-33.69	-3.84	-9.95	5.18
27241104	39.701064	-80.856565	0.52	3.61	0.31	0.8	4.4
27241105	39.701185	-80.856612	-4.94	-34.11	-3.25	-8.43	5.52
27241106	39.701561	-80.85665	-4.96	-34.24	-3.44	-8.94	5.2
27241107	39.701566	-80.856615	-5.06	-34.93	-3.51	-9.1	5.19
27241108	39.703224	-80.85457	-1.95	-13.43	0.38	1	4.67

27241109	39.703232	-80.854504	-1.45	-9.99	-0.16	-0.41	4.29
27241110	39.702939	-80.854813	-3.3	-22.76	-2.13	-5.54	3.88
27241111	39.703239	-80.854451	-1.3	-8.95	0.24	0.61	4.64