IDS NORTH AMERICA
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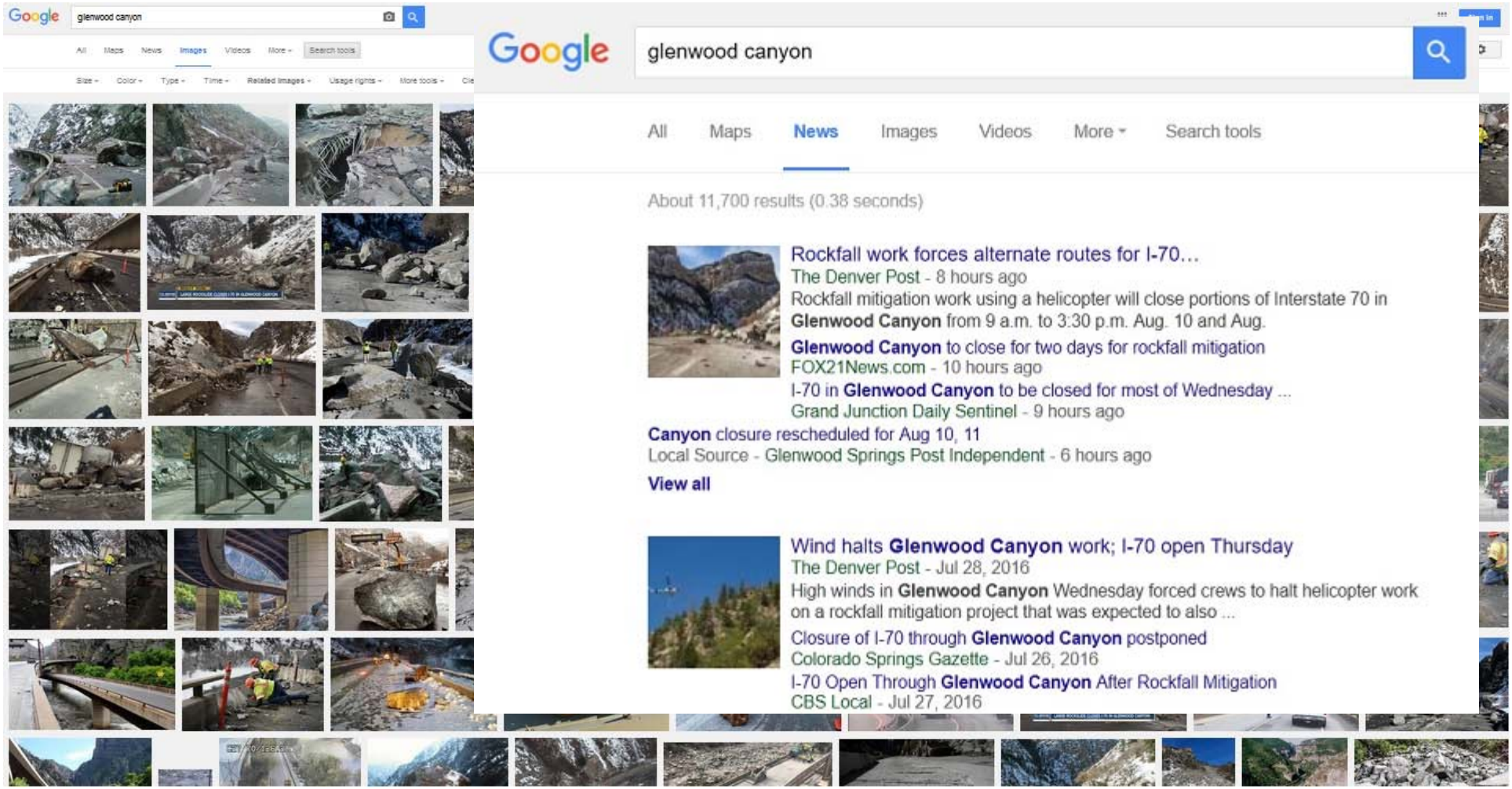
16th Annual Forum
Geohazards Impacting
Transportation in Appalachia

Field Deployment Under Urgent and Emergent Conditions DOT Support for Scaling Team and Basic Alert Management, the Case of Glenwood Canyon (I-70) February, 2016

GSI GeoStabilization International®
Geohazard Mitigation Experts

Glenwood Canyon – Scope of Issue Local and National



CDOT: The average daily traffic for Glenwood Canyon is around 300 vehicles per hour. In the summer season, that number can swell to around 500-600 vehicles per hour.

Detour costs are estimated at 1.3 to 1.6 million dollars a day in commercial losses.

Event Timeline 2016

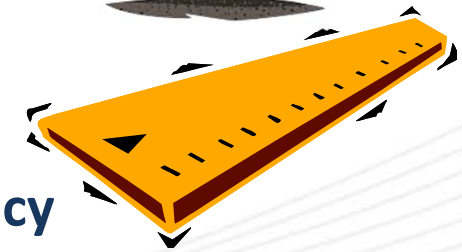
- 2/16: Rockfall events in the evening take out semi – I-70 closed.
- 2/16: IDSNA contact Ty Ortiz – CDOT Geohazards Program Manager and Sector colleagues.
- 2/17: IDSNA Call and left message offering to assist.
- 2/18: IDSNA receive inquiry from CDOT: "How quickly could the trial warning system be deployed? We would like to look into it, at for the duration of the repairs."
- 2/19: IDSNA VP GeoRadar, Bus. Dev., Customer Care **team travel to GC for site assessment** with CDOT and GSI staff.
- 2/20: IDSNA staff meet in Golden office, review instrument configuration and brainstorm deployment needs. (Railroad right of way crucial) – Trailer rigging for lift, welding, cellular mods (networking), extended battery pack, genset and fuel.
- 2/21: Partial reopening of Eastbound Lanes.
- 2/22-24: UPRR site visit, clearing, rail crane order.
- 2/25: **IBIS unit deployed and scanning.**

2/16-2/23 - Site Geotechnical Assessment/ Active Chutes

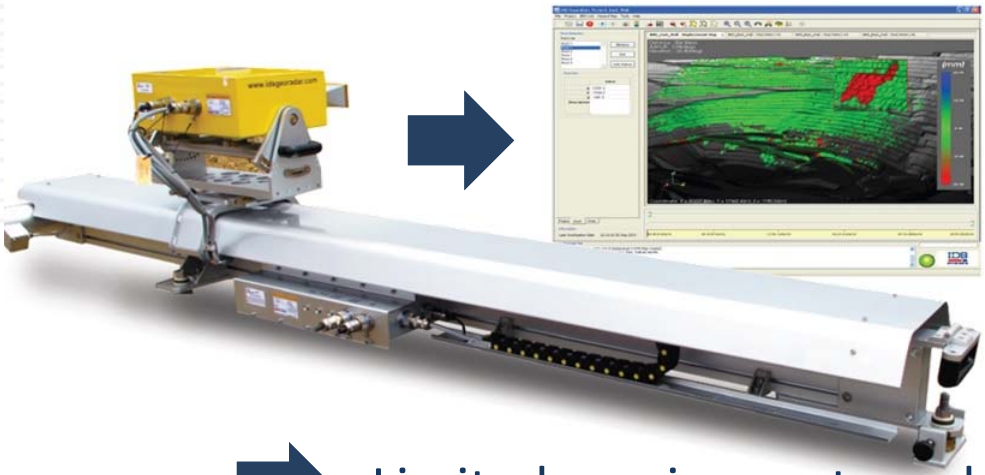
IBIS-FM

… a **modular system** for flexible **deployments**

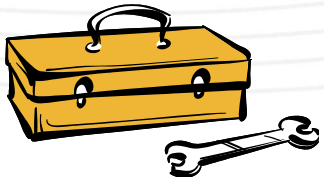
- Scan time independent from coverage - **less than 3 min**
- Long scan range (**up to 4km / 2.5mi** i.e.away from working/blasting areas) and wide coverage



- High spatial resolution and **sub-millimetric accuracy**



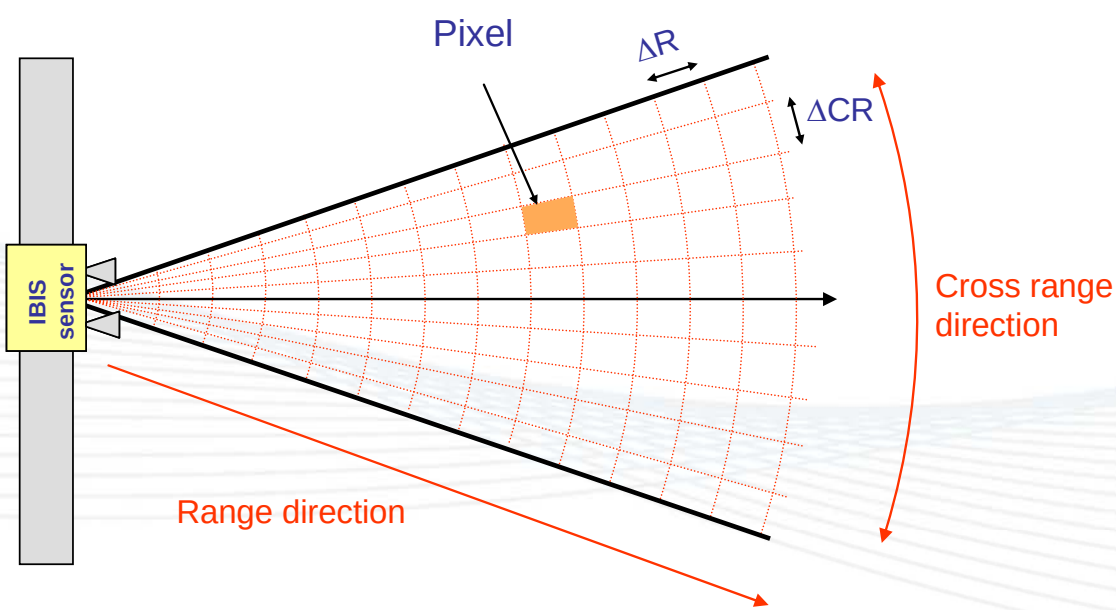
- State-of-the-art **processing and atmospheric correction**
- **No system pause for** strong winds



- Limited moving parts and **reduced maintenance**

IBIS-FM Area coverage, spatial resolution, scan time

Spatial resolution



Typical area coverage:

80° of horizontal aperture and 60° of vertical aperture

Typical spatial resolutions:

- range bin: 2.46’
- cross-range: 14.1’ @ 3,281’

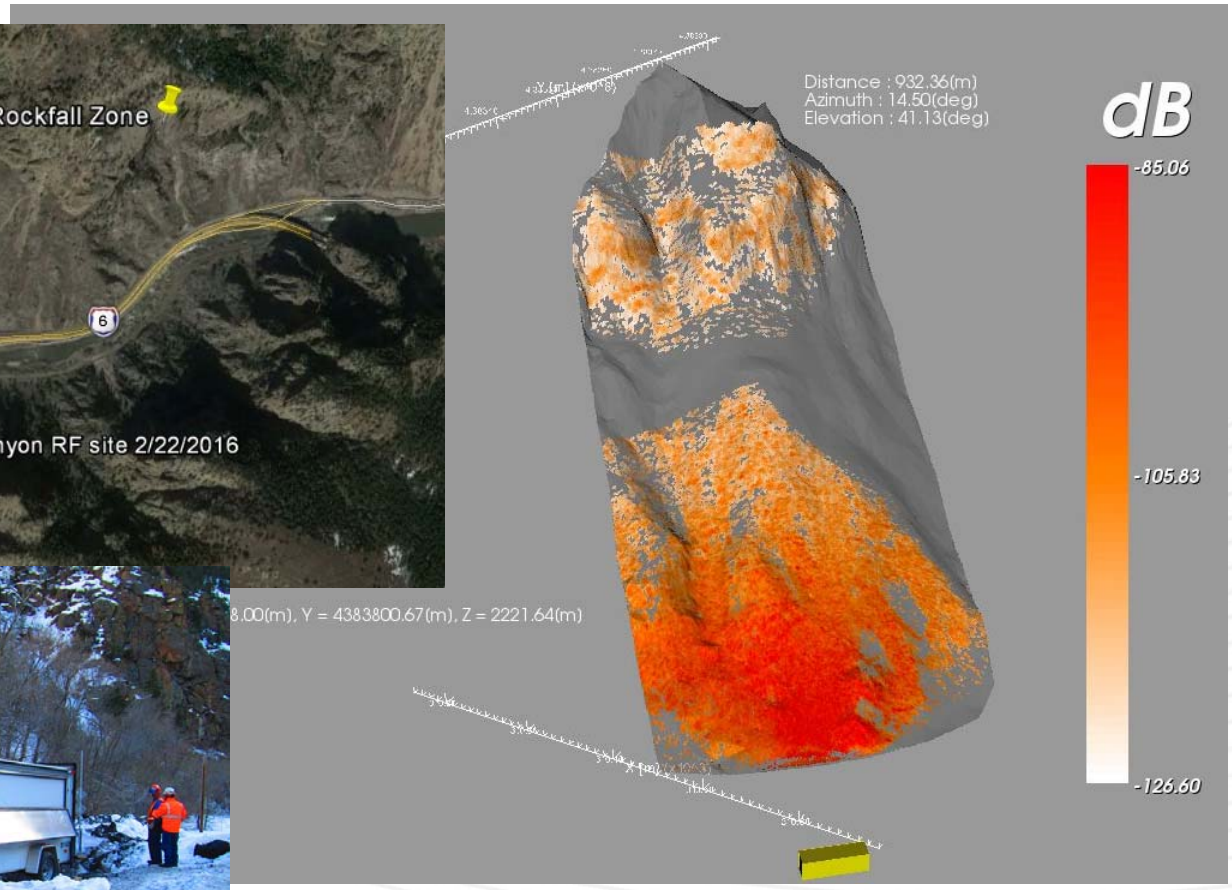
Typical scan time:

- typically 2.5 min for a full resolution image @ 6,562’

IBIS Instrument Configuration and Preparation

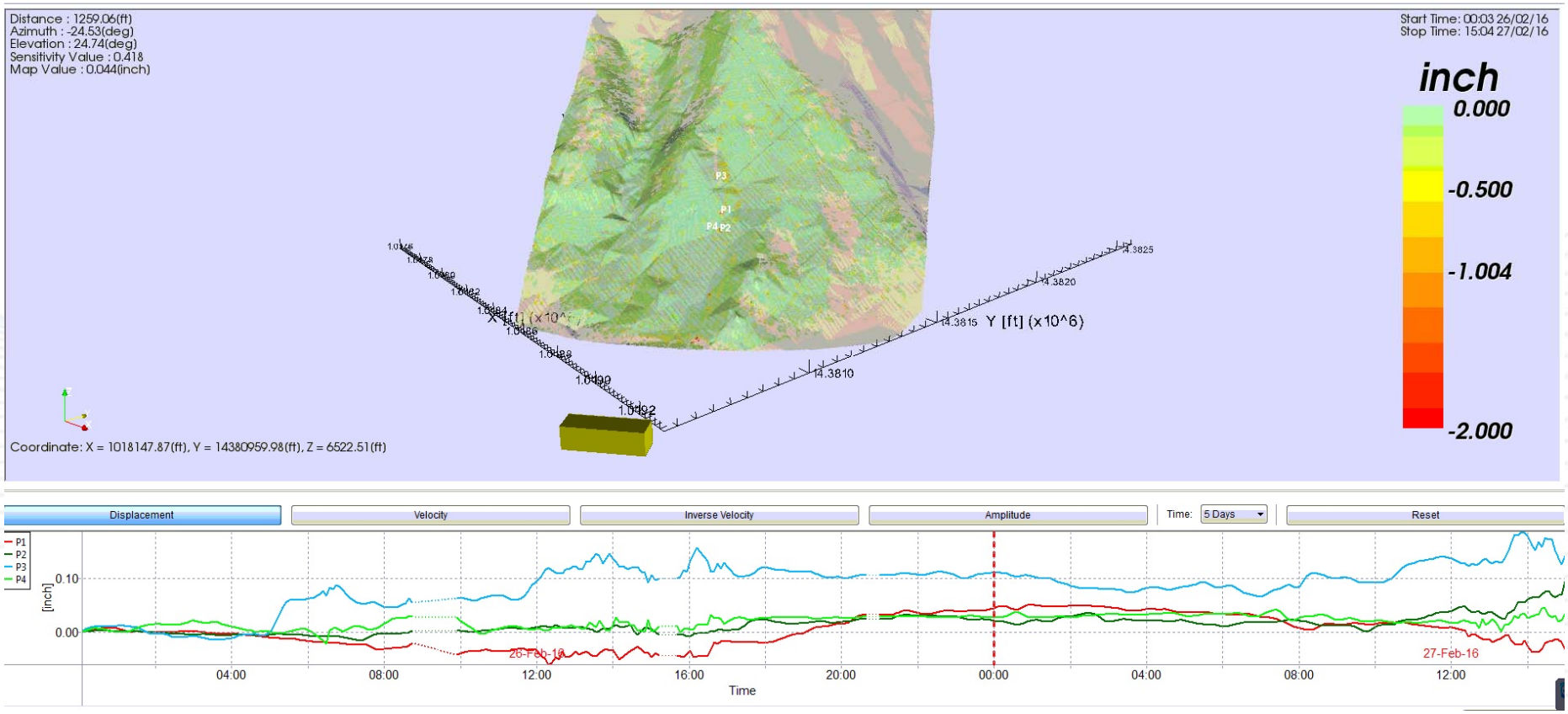
IBIS-FM Site Deployment: UPRR Coordination and Support

IBIS-FM Site Deployment: Skids / winch under power line

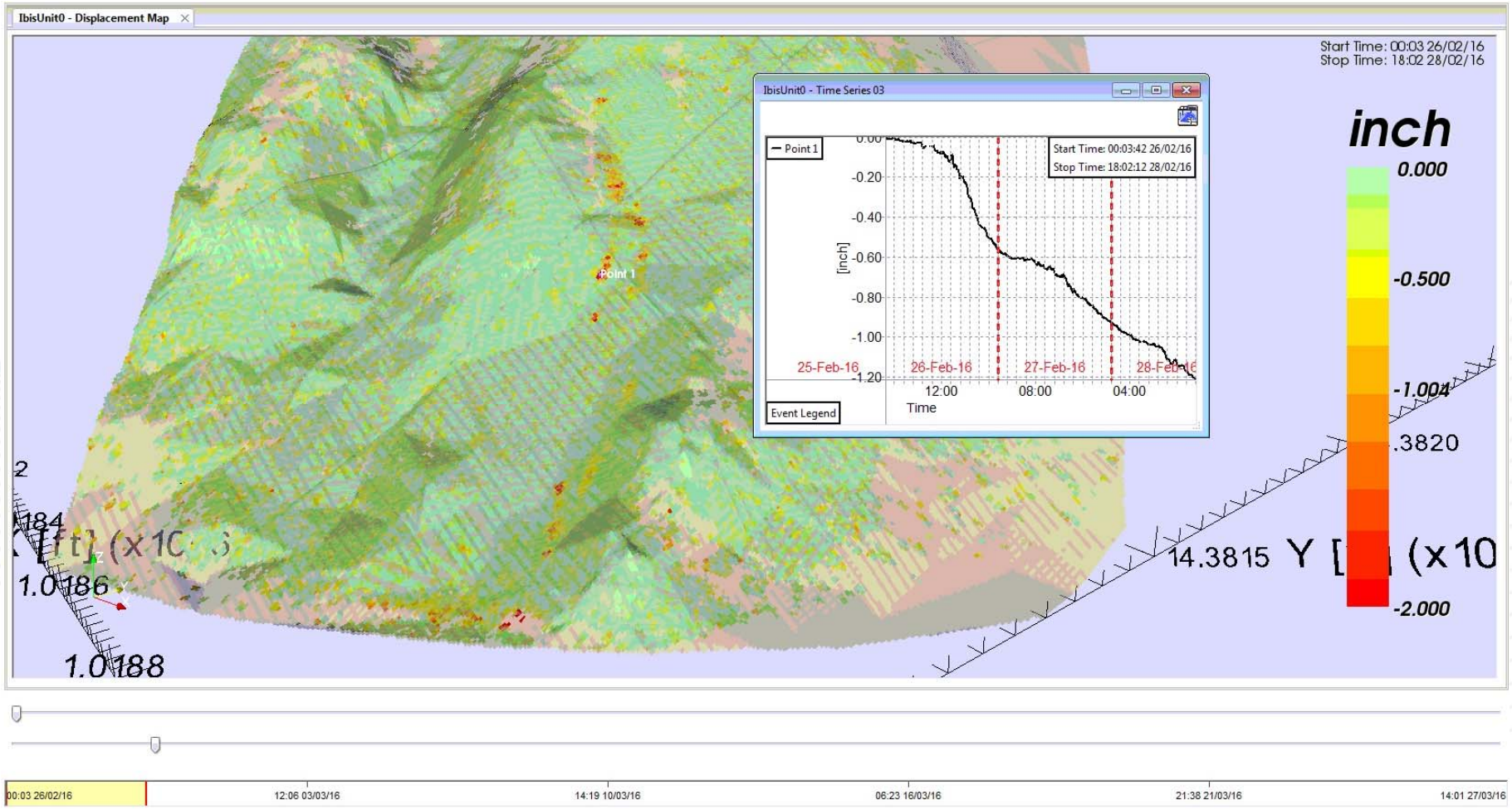


IBIS-FM ready to scan – acquire DTM

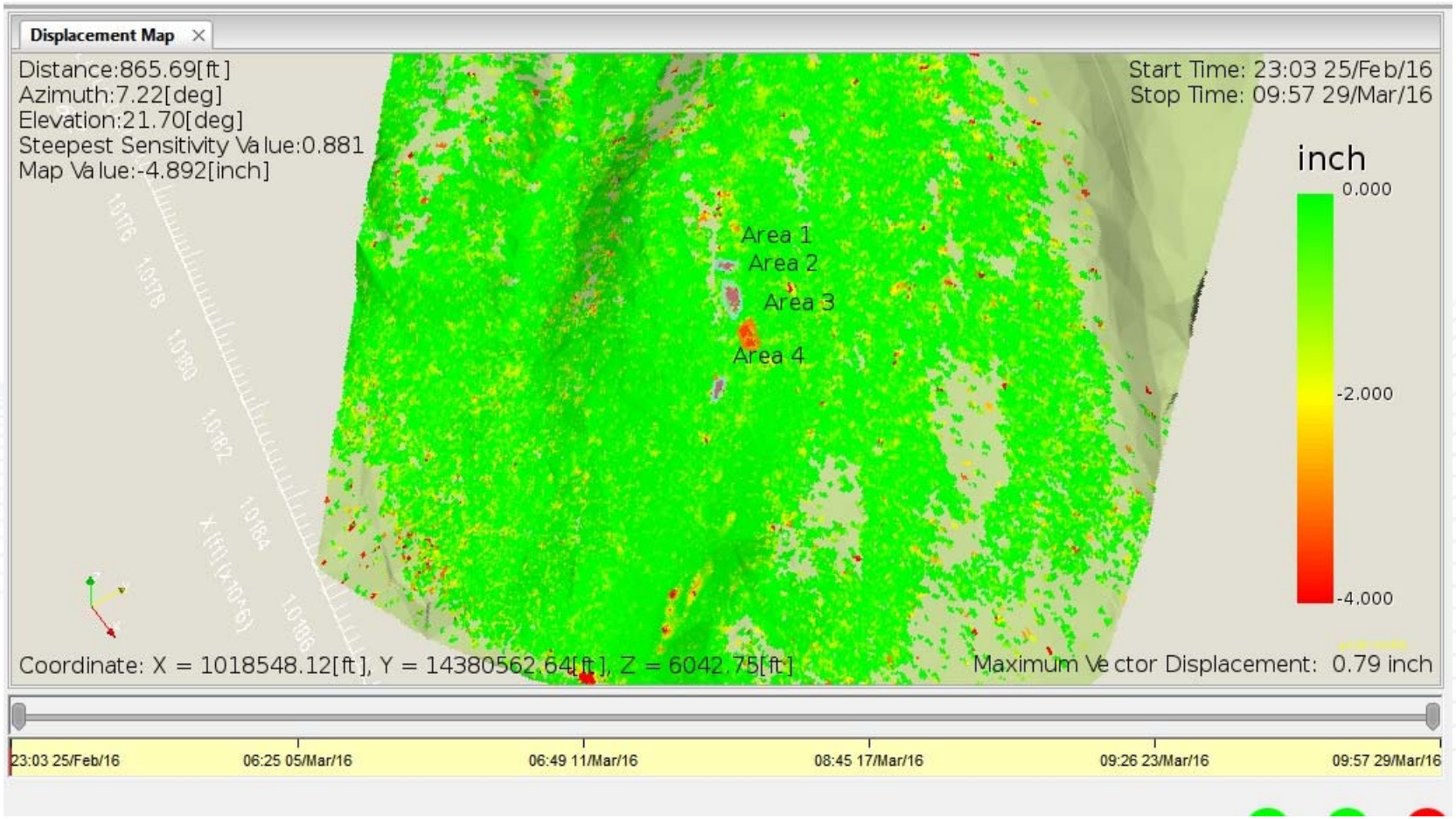
IBIS- FM scanning begin 2/25/2016 each scan < 3 minutes



Data: 3 days 1 “point” : range – 935’ cell size 3.28’



Data: 34 days Area 3 – 62 cells = 804 square feet



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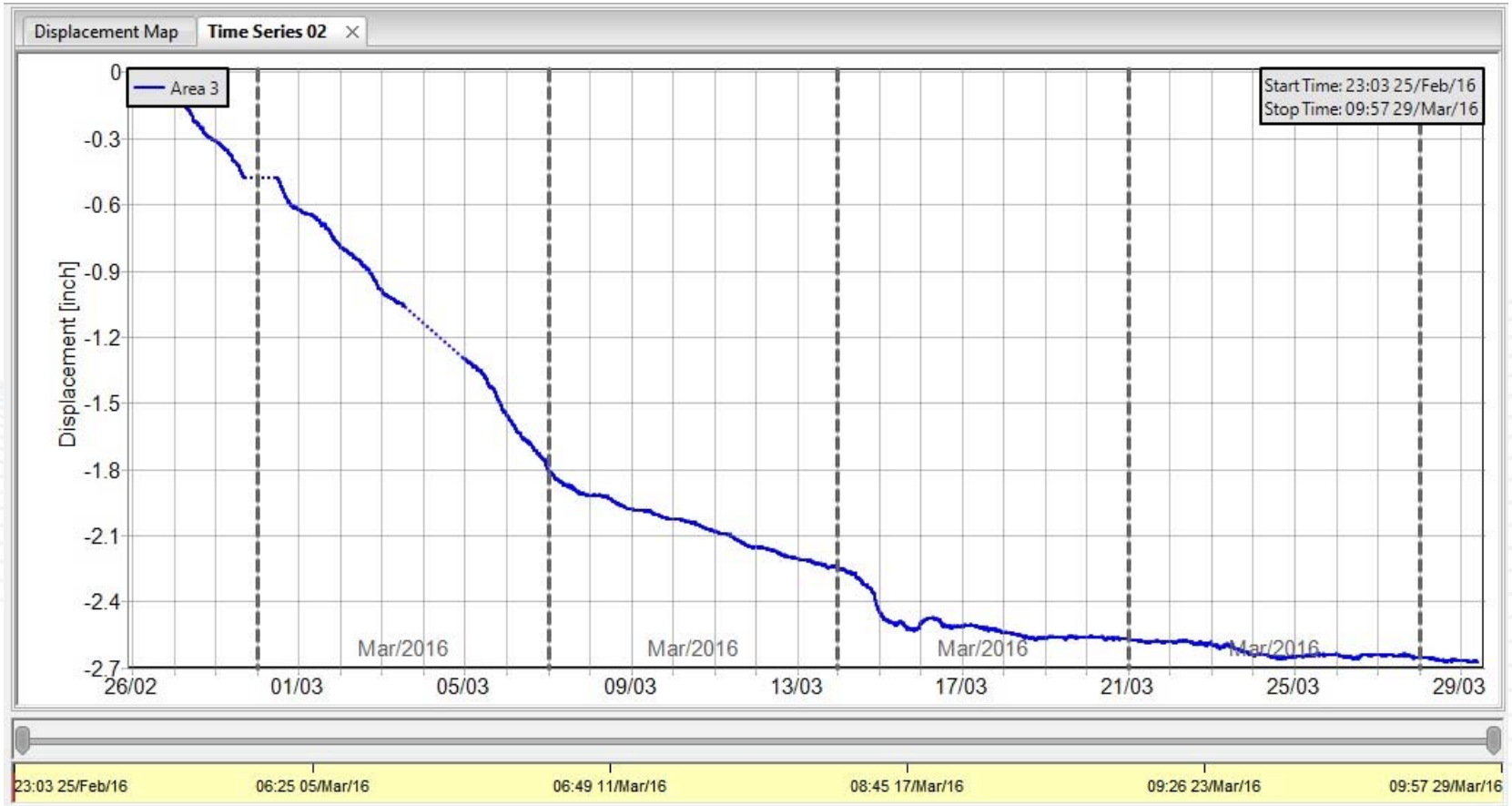

Reporting: General System Report

CDOT_Glenwood Canyon
Commercial in Confidence

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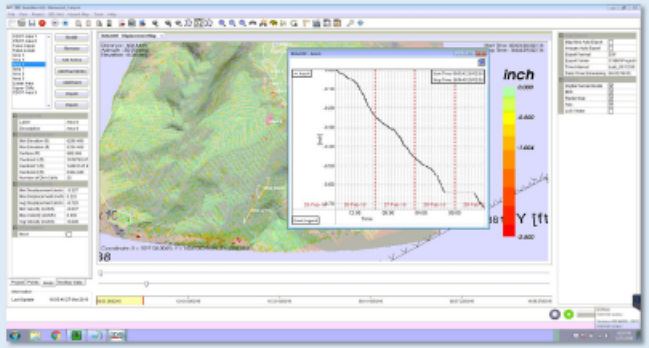
DAILY SYSTEM REPORT
CDOT/GSI - Glenwood Canyon, CO: UNIT - IBIS-M

Contact Info: IDSNA Tech Support: 1 855 399 4247
john S. metzger - j.metzger@idscorporation.com - 303-726-6024
Jake Davidson - j.davidson@idscorporation.com - 720-626-5101

DATE	Monday, February 29th, 2016	IBIS Project : Glenwood Canyon (Devils Hole Creek)
SYSTEM STATUS	Site: Devils Hole Creek: MP 351.89 Engine Time: 618 Min. Power: AC line/battery System Time = 77 Hours System Availability Hours = 77 Voltage = 27.8 Sensor Temp: 121° F	**Glenwood Canyon** - IBIS unit was restarted today at about 11:00 AM. Following the line disruption and surge, IDSNA installed a new power inverter for the cellular booster, rewired the input from th GPR AC line and added additional cells. Genset was placed in reserve, as batteries are sufficient for 3-4 days runtime. IBIS data is viewed in the Guardian software suite. Below we can see several areas chosen for specific time series or other graphs. *Within the Figure below we clearly see the aggregate displacement for Area 4 (appx. 582 SQ Ft.) that is compromised of 35 DTM cells.* Hazard areas and alerts can be user configured with consideration for appropriate displacement indicators or velocity rates. These alerts are visible, logged, and can be shared over SMS messaging or by e-mail. IDSNA will support CDOT in the selection of generalized rates, and the accelerated amounts that can be set for specific "level" of alerts. Alerts should be specifically linked to a event or emergency action plan.
ERRORS	TCP Connection	
ALERTS	None	
COMMENTS	Power Inverter replaced. Genset placed as third support. AC line reconnected, batteries added.	
IDSNA Support	SYS response: A. AC line connection replaced and system restart at 11:00 AM successful.	



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DAILY SYSTEM REPORT
CDOT/GSI - Glenwood Canyon, CO: UNIT - IBIS-M

Contact Info: IDSNA Tech Support: 1 855 399 4247
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Event Notes or Data

DATE	EVENT	NOTES	OTHER
2/26/2016	SYS responding well.	DTM to be available next week.	Initial data acquisition begun, weather ok - some snowfall - generally clear. Remote Communication good, then interrupted data secured on local PC.
2/27/2016	SYS responding well.	DTM flight aborted, Plan C in effect.	System tracking data well and logs denote railroad cars passing with data overflow present. Power surge on Comms inverter line resulted in failed inverter, to be replaced, line power discussion in process.
2/28/2016	SYS scanning, powered down at 6:14 due to low battery alert.	DTM team to visit site on 3/2/2016	IDSNA to add hi-capacity cells and reconnect to main AC line after surge event. Genset battery start low voltage halted genset start. Customer Care team will reset limits, alerts and add 2-3 days of battery access.
2/29/2016	SYS scanning restart began at 11:00 AM	DTM team to visit site on 3/2/2016	General system response is good, IBIS unit not affected by power event of 2/28; Suggested alert scenarios to be shared with CDOT team.

General Note and Disclaimer

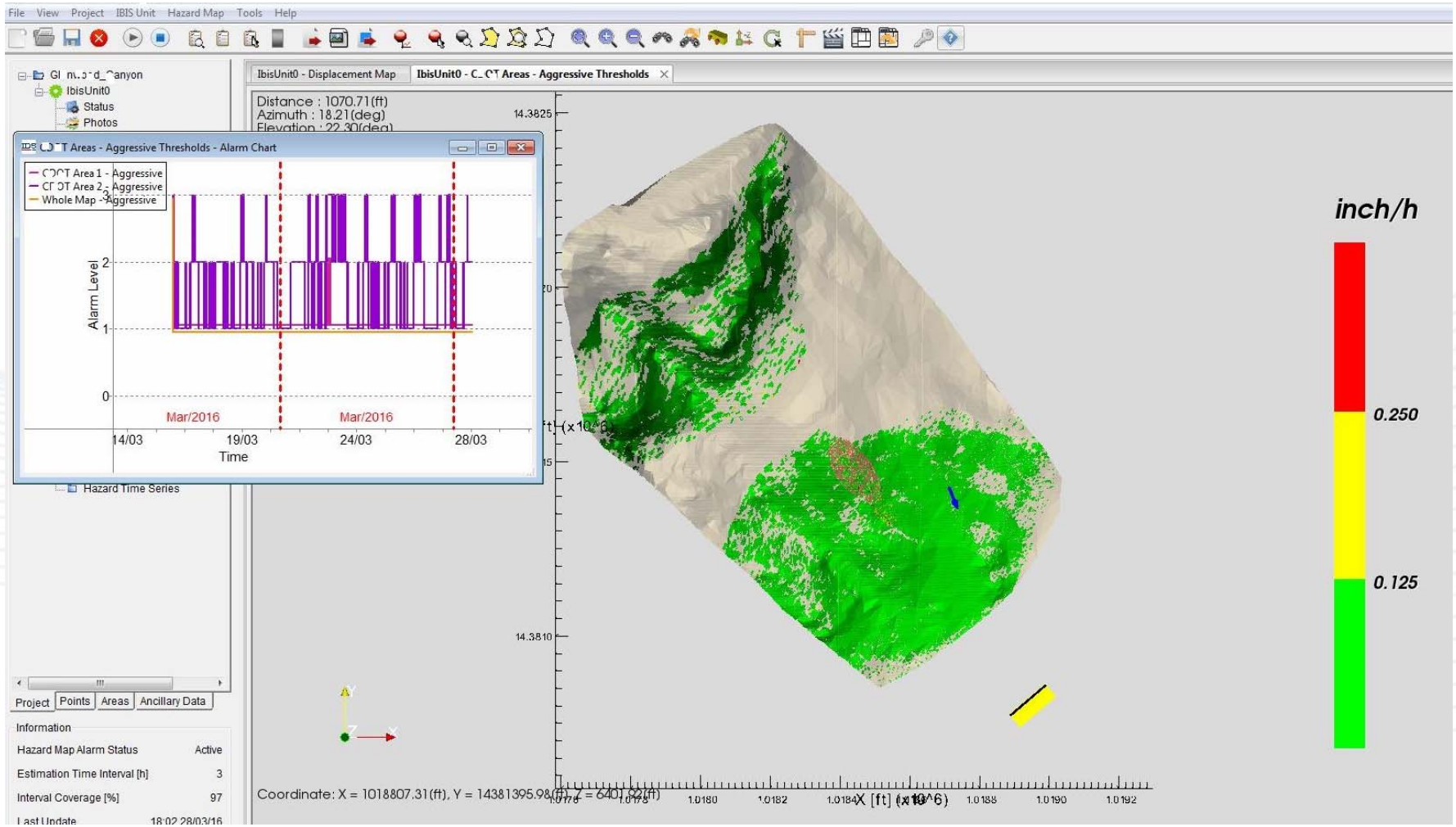
1. It is understood and agreed that the information provided is based on data from an interferometric radar measuring instrument. That data cannot be considered reliable at 100% in its content or delivery. Technical, on site, general anomalies, and the limitations of the laws of physics may affect the instrument readings.

2. It is further understood and agreed that the Supplier (IDSNA) cannot be liable to the Customer, or any agent or associate of the Customer, for any mistake or error in judgment, or for any act or omission related to any instrumental failure, lack of and or misreading of data, or in any case a judgement or sharing done in good faith and believed to be within the scope of authority conferred or implied by this Agreement.

3. That this General Note and Disclaimer covers all materials within the context of this joint effort.

2

HAZARD MAPS Aggressive Alerts – Level 1 and 2 in inches per hour



Weekly Reporting: Data Quality and Highlights

IDS

Date: 15/03/2016
Reference No: 5746-16-001

1 Summary

The IBIS-M unit performed as normal during this time period. The IBIS unit is running on line power provided by Union Pacific Railroad (UPR) and is backed up by four large capacity batteries. During the time period covered by this report, work on the slope was completed (on approximately the 10th of March), so this report covers a period where personnel were working on the slope and when they were not.

Movement trends during the week tended to be linear, with very few large scale acceleration trends exhibited. Some small acceleration trends were present that lasted approximately 24 hours. Areas described in this report were selected by IDSNA personnel as they indicated regular and significant displacement during this monitoring period. The areas in this report are shown in the image below (indicated with black arrows). This report will focus on the areas called "Area 4," Area 7," and "Area 8."

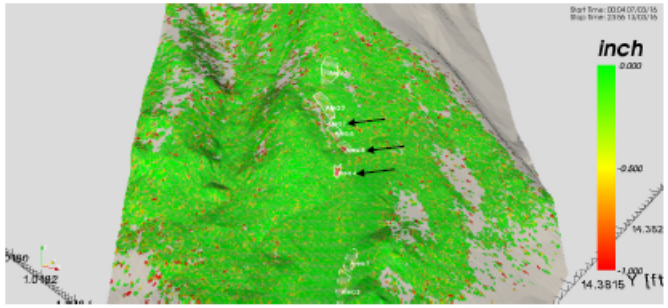


Figure 1. DTM, IBIS data, areas 4,7,8 indicated.

Table 1 below, shows some basic statistics of the areas noted in Figure 1 of this report.. It should be noted that all displacements in the direction of the radar (i.e. down slope) are shown as negative values.

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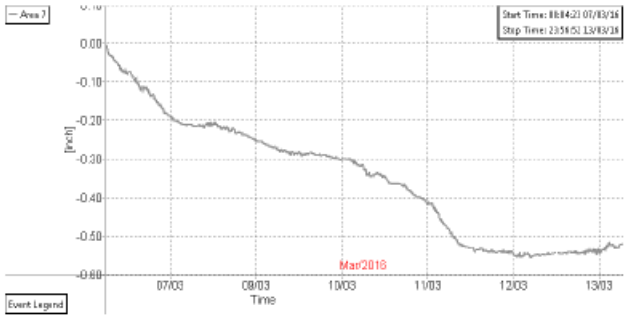
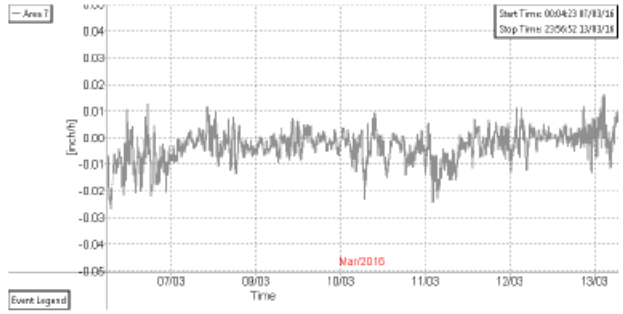
Date: 15/03/2016
Reference No: 5746-16-001

2.2 Area 7 Graphs

Displacement Time Series:



Velocity Time Series (1 hr average):



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6/9

Glenwood Canyon Event - Deployment Highlights

- Days Scanning = 34
- Hours scanning available = 802
- Number of Scans = appx 16,040
- System Availability % = 98.3 percent
- Cost per hour < $40.00