

塑造智慧变革



HEXAGON

海克斯康



北京
国家会议中心

2018年

9月10-12日

2018.hexagonchina.com.cn

IDS
GeoRadar



Radar Solutions for Slope and Structural Monitoring

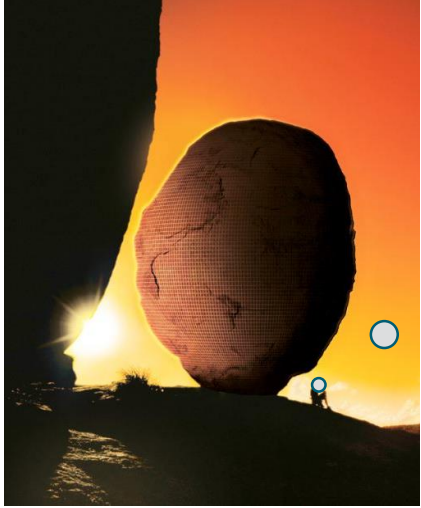
创新的监测技术 --Radar在滑坡监测中的应用

Alberto Bicci

September 2018

Game changing Radar solutions for sub-millimeter displacement monitoring

雷达技术用于亚毫米级位移监测

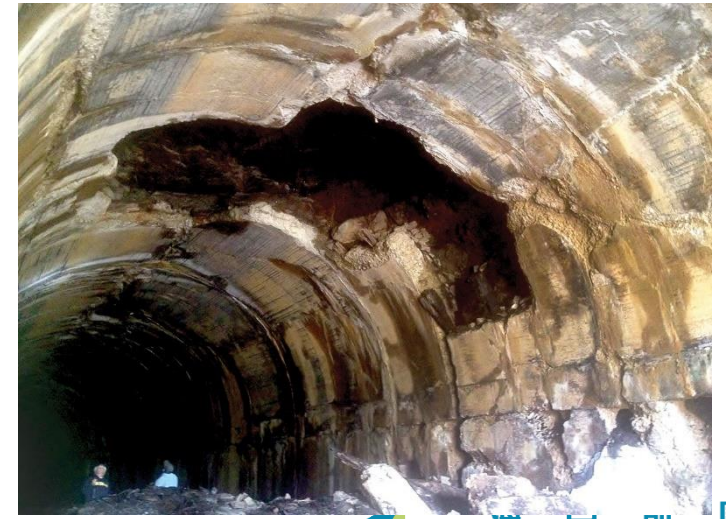
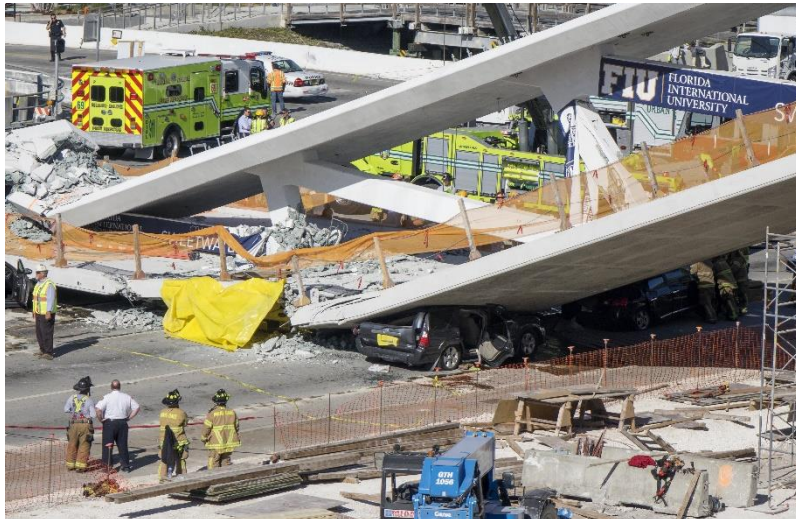


.....ARE YOU INTERESTED
AT THE MOVEMENTS ?

你对这些位移监测感兴趣吗？



- Mine slopes 矿山滑坡
- Landslides 山体滑坡
- Bridges 桥梁
- Buildings 建筑
- Tunnels 隧道
- Underground Mines 地下矿井



Monitoring : Risk Management and Mitigation Technologies ... which one to choose?

监测:管理和减少风险, 选择哪一种监测技术?

Point by Point Mm/cm accuracy

单点毫米/厘米级精度

Areal Submm accuracy

区域亚毫米级精度

Topographic
Instrumentation
地形测量仪器



Total Station 全站仪



GPS



Biaxial Clinometers 倾斜仪



Laser Scanner 激光扫描仪

Geotechnical
Instrumentation
岩土测量仪器



Transverse and Longitudinal Electrolevels

横向和纵向电子水平仪



Inclinometer

倾斜计



Multi-parametric chains in hole

孔内多参数链

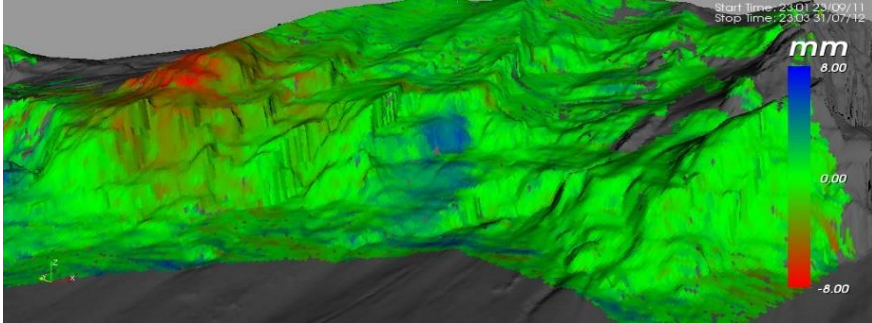
InRA
Instrumentation
InRA仪器



IDS
GeoRadar

Why Radar technology is a game changer in Monitoring

为什么雷达技术颠覆了监测行业的监测模式？



No reflectors required

Displacement map, not only discrete points

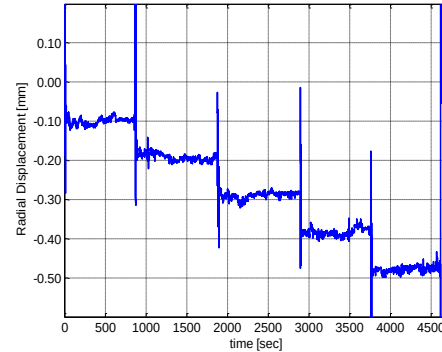
无需反射棱镜：不只是离散点，还有位移图

All weather: fog, rain, snow

全天候：雾天，雨天，雪天



0.1 mm displacement

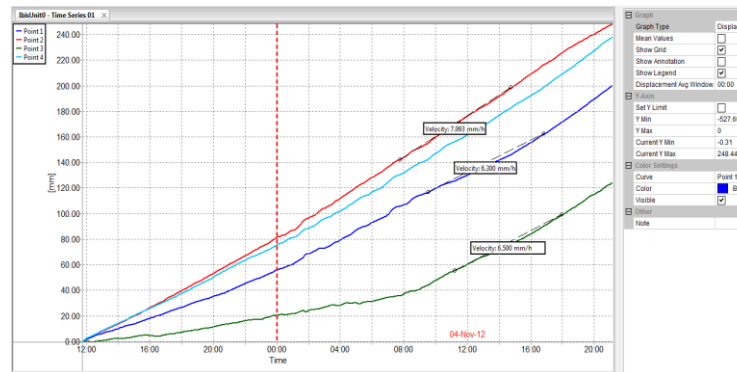


Sub-mm displacement accuracy

亚毫米级位移精度

High acquisition frequency

高频率

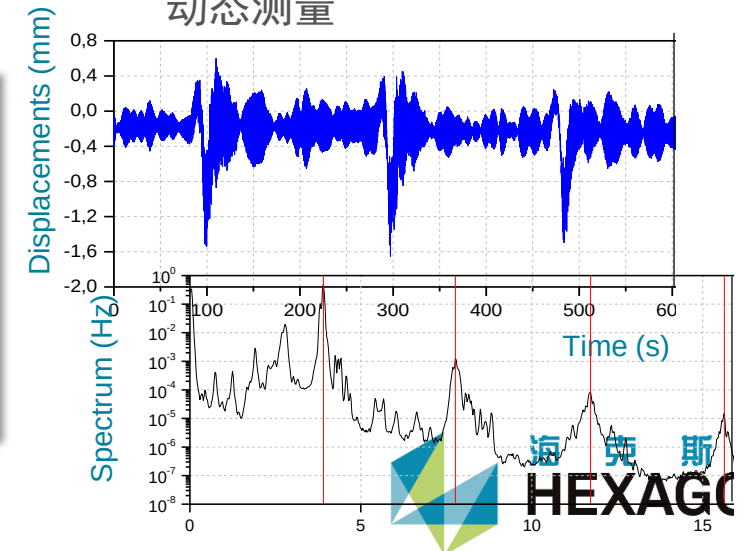


Long Range: up to 5 km

距离高达5km

Measurement of dynamic behaviour

动态测量



Radar solutions for landslides and structural monitoring

滑坡和结构雷达监测解决方案



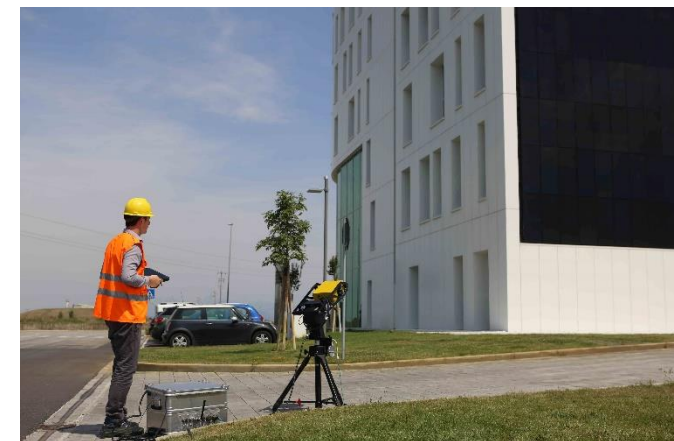
IBIS-FS:

- SHM
- Dynamic and Static Monitor.
- 动态和静态监测
- 1D monitoring
- 一维监测



Hydra-G:

- SHM / Cutslope / Dam / Tunnel /
- 3D Structural monitoring 三维建构监测
- Short range / large angular view 短距离/大角度观测
- 2D/3D monitoring 二维/三维监测



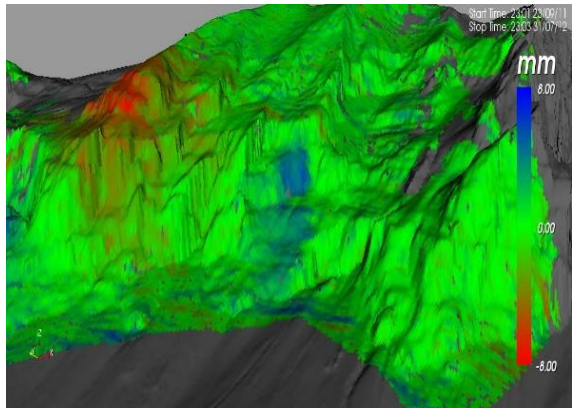
IBIS-FL/FM:

- Landslide / Dam Monitoring 滑坡/大坝监测
- Long range 长距离
- 2D monitoring 二维监测



Landslides and dams monitoring: IBIS FL/FM

滑坡和大坝监测: IBIS FL/FM



- ✓ No access requested to the area: Technicians & Instrument in the safe zone 无需进入危险监测区域
- ✓ Extensive displacement map covering large area 大区域位移形变图
- ✓ Operative day & night, also with fog, rain and strong wind 全天候监测
- ✓ Set up of early warning alert 设置监测预警

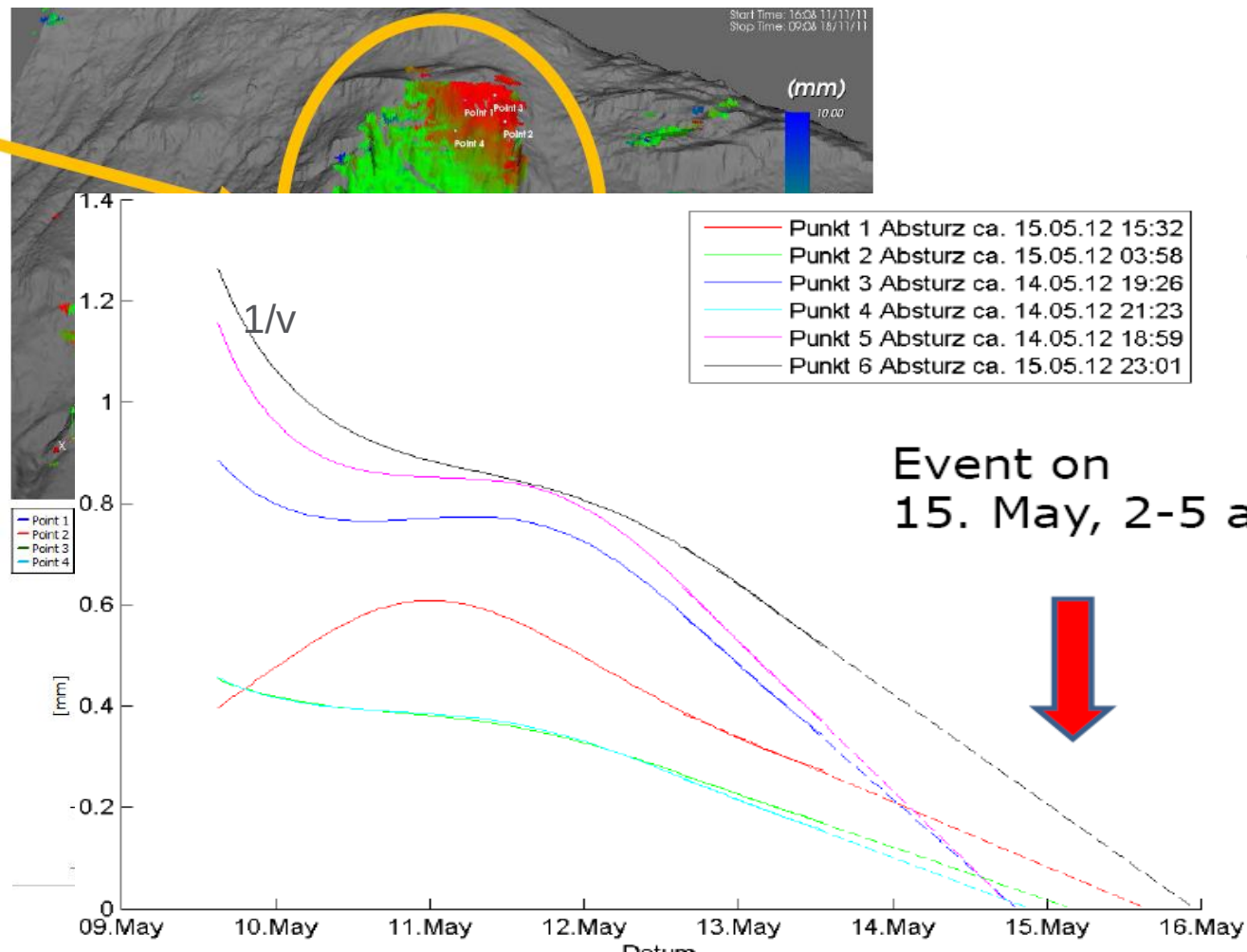
Prediction of a slope failure at Preonzo (Switzerland)

Preonzo (瑞士)滑坡预测



View from the valley to the landslide in a distance of about 2 km (altitude difference 1200 m)

山谷向山体滑坡的距离约2公里(海拔1200米)
(courtesy of GeoPraevent)

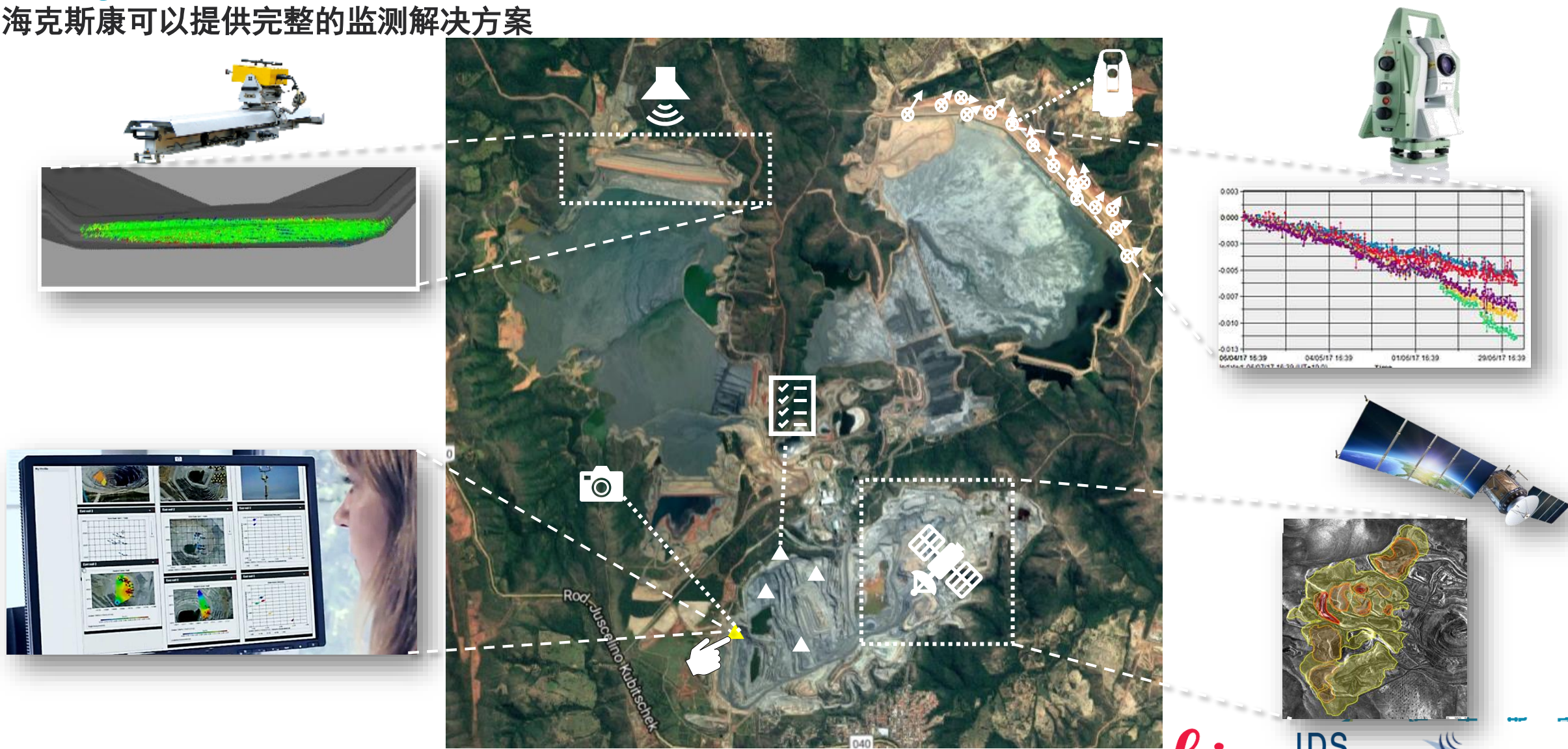


- Plot of inverse of velocity predicted the time of failure
- 通过形变反演滑坡速度图预测滑坡发生的时间

Large monitoring projects require the integration of different technologies

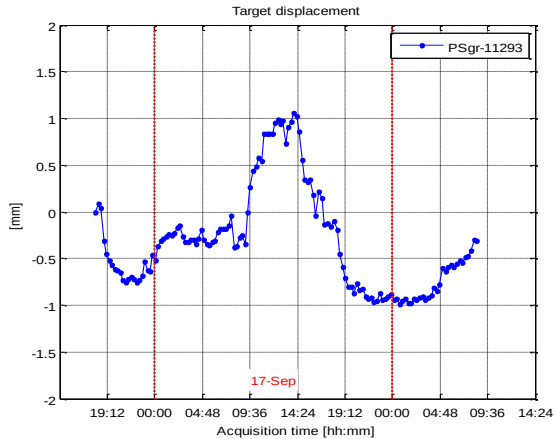
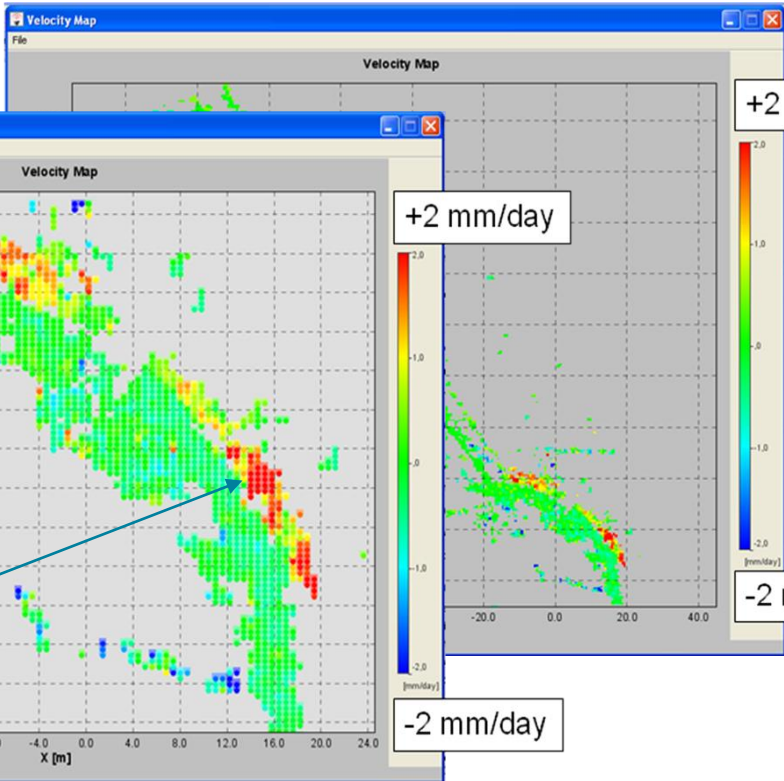
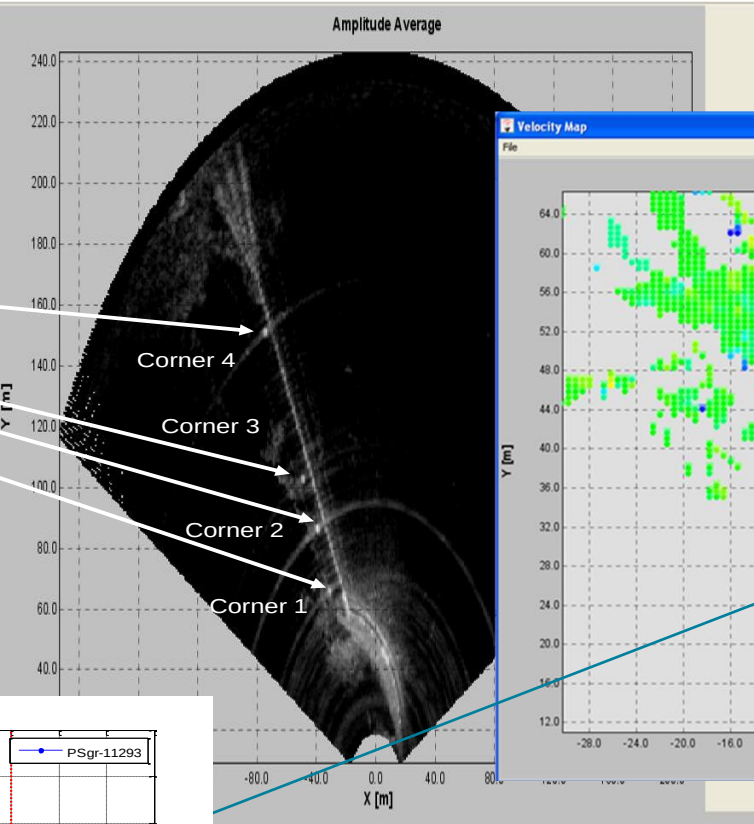
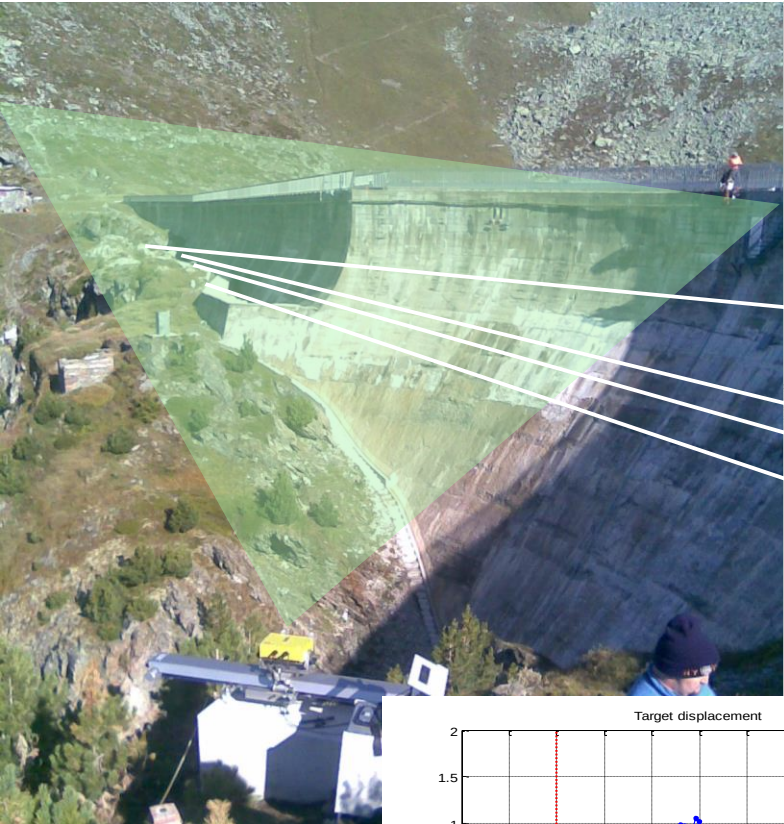
Hexagon can offer the whole solution

海克斯康可以提供完整的监测解决方案



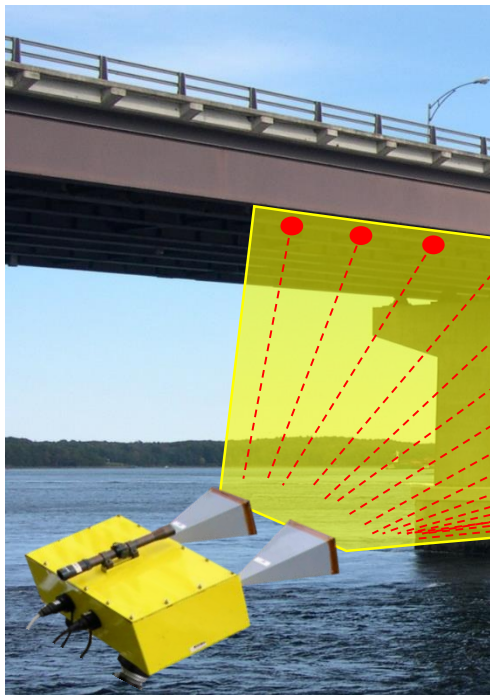
Dam monitoring: remote monitoring

大坝监测：远程监测

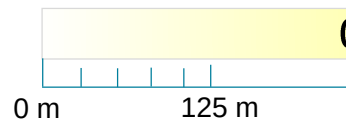


Bridge structural monitoring: IBIS FS

桥梁结构监测: IBIS FS



Accuracy



- Remote measurement:
- Many structural points s
- High displacement accu

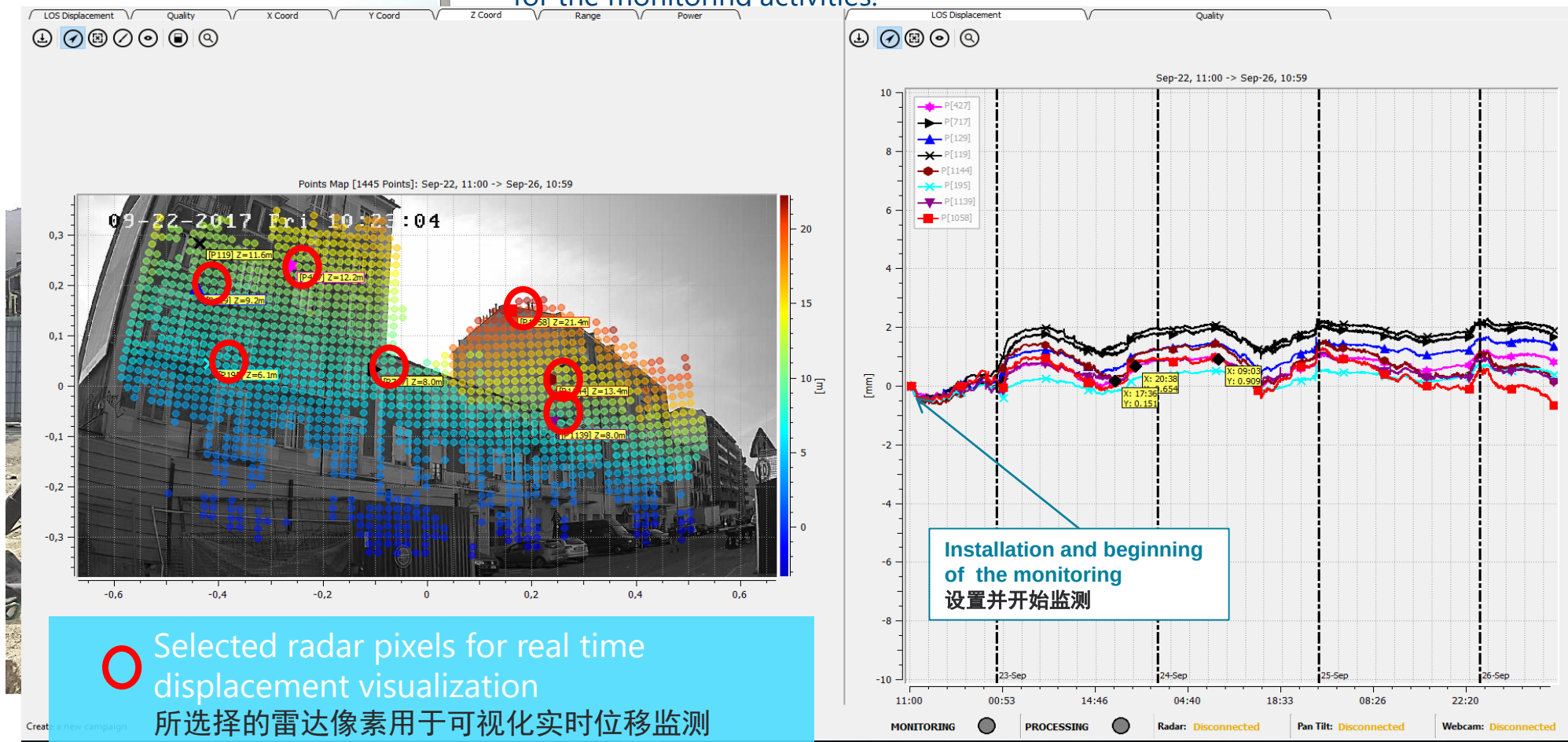
Unique for difficult to access structures 难以到达监测点的独特解决方案



Hydra-G: real time, remote building monitoring (subsidence from TBM excavation)

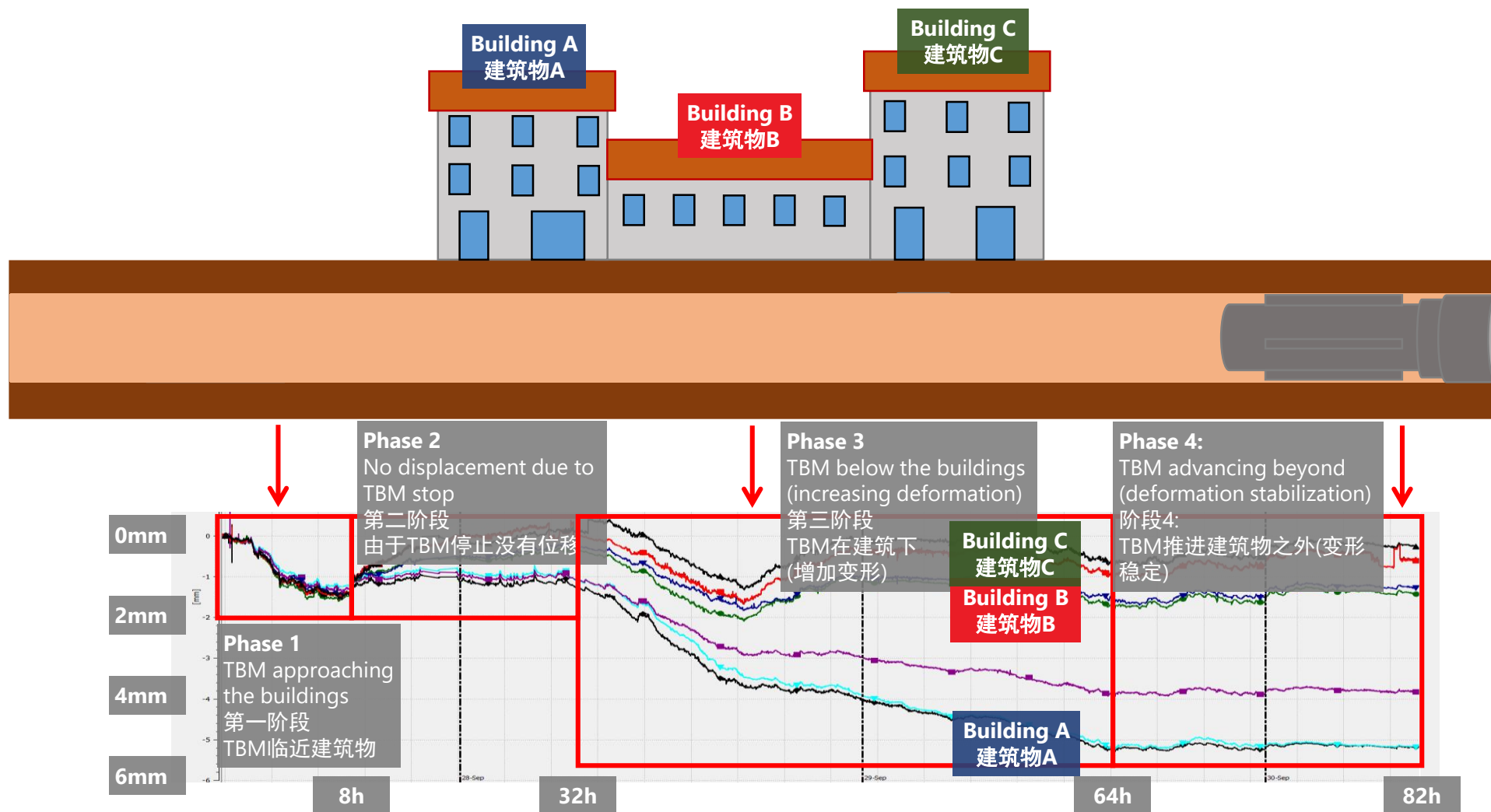
Hydra-G:实时、远程建筑监测(TBM掘进引起的沉降)

The blue square in the image below indicates the buildings that were selected for the monitoring activities.



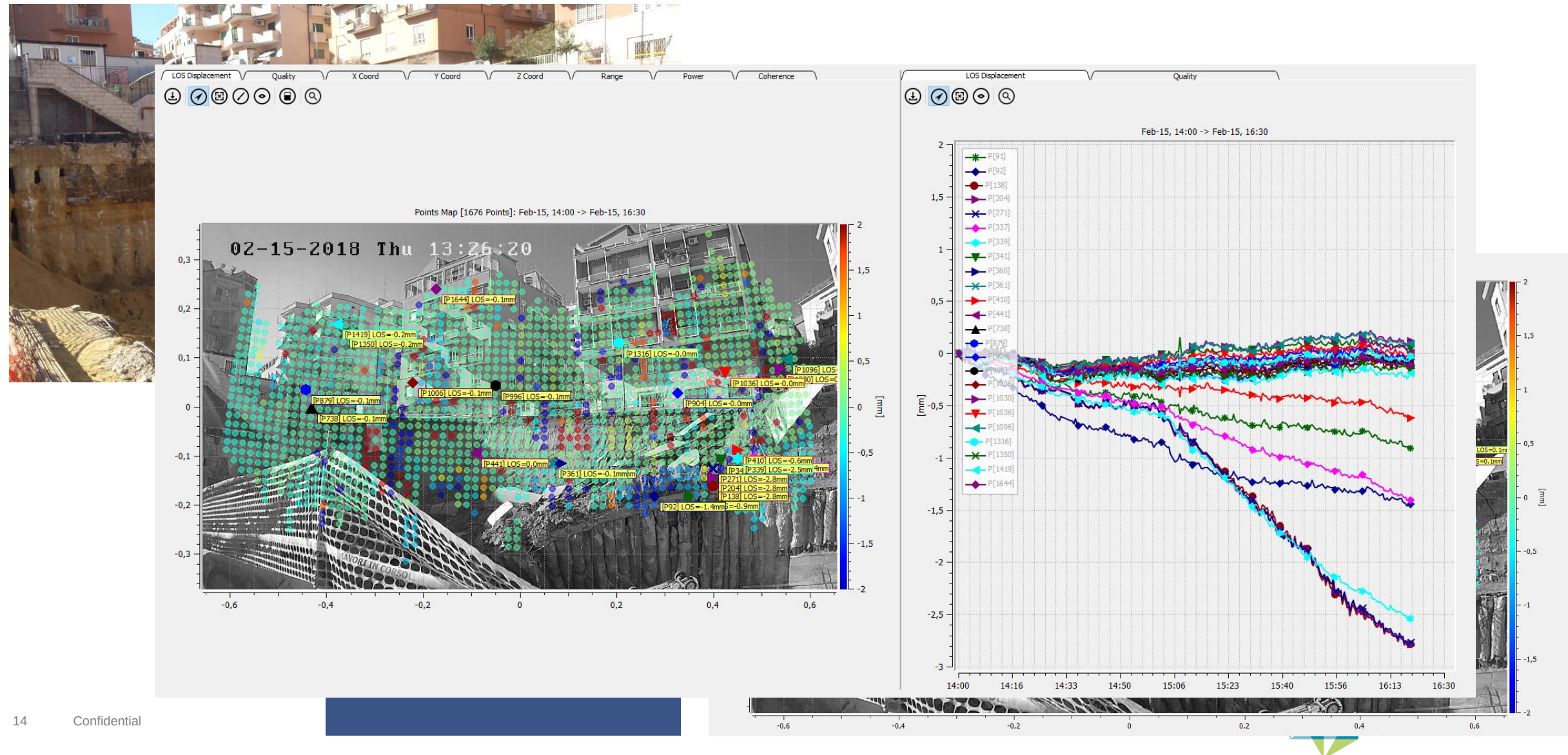
Real time monitoring by Hydra-G during TBM excavation

TBM掘进过程中，Hydra-G实时监测

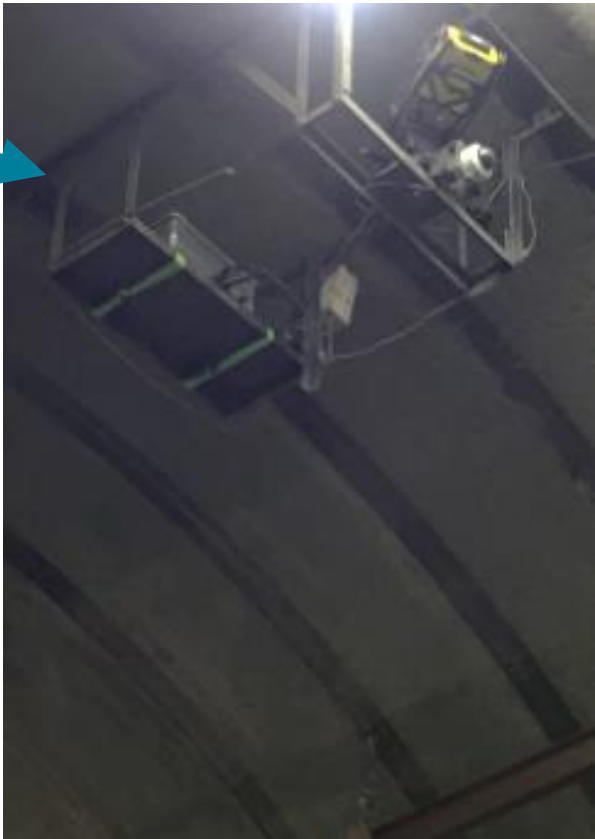
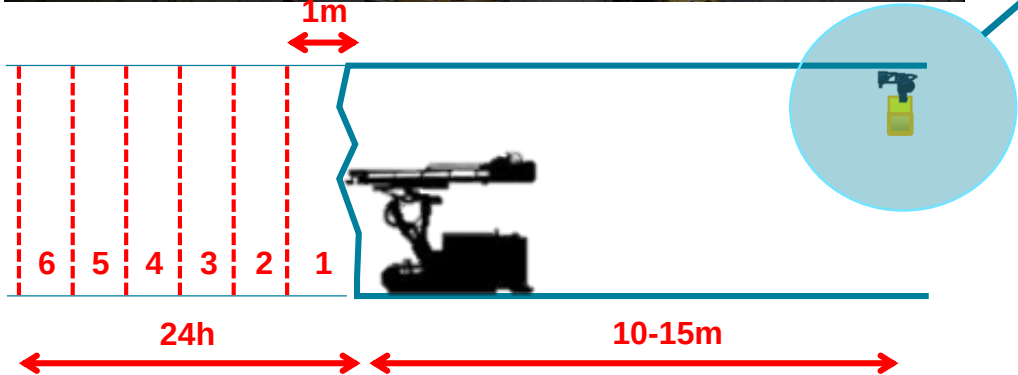


Monitoring of building instabilities following disasters

监测灾后建筑物的不稳定性



Tunnel monitoring during construction 施工期间隧道监测



Hydra is setup 10-15m from the excavation face and is moved ahead every 3-4 days when the distance from the front face becomes higher than 30m

Hydra安装在距开挖面10-15m，当距离开挖面大于30m时，每3-4天移动一次

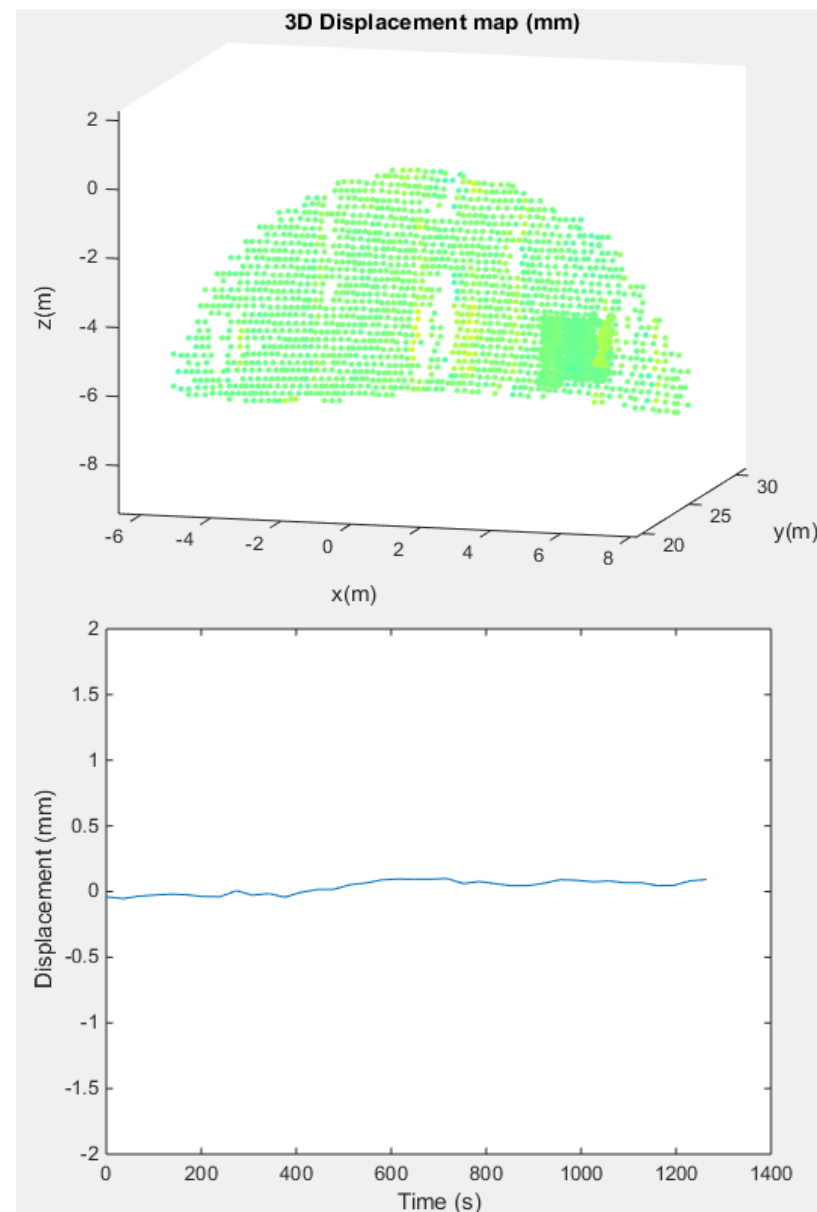
Tunnel monitoring during construction 施工期间隧道监测



10.09. —————> 10.36.

The tunnel face after excavation appears stable, only very slow movement detected in the lower part

开挖后的隧道工作面稳定，仅下部有非常缓慢的位移变化。



Monitoring Radar solutions for the Mining industry

采矿业雷达监测解决方案

Game-changing Evolution

引领行业的变革



2009



1st Generation SAR: IBIS-FM

Fixed and semi-permanent long range monitoring, for both strategical and tactical purposes. First commercial SAR.
第一个商业SAR用于战略和战术目的的固定和半永久远程监视。

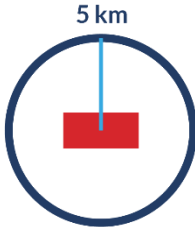


2015



2nd Generation SAR: IBIS-Rover Mobile

First Rotating, mobile SAR for mid-range monitoring in multi-pit mines and complex geometries.
第一个旋转移动SAR用于多矿井和复杂地质条件下的中距离监测。

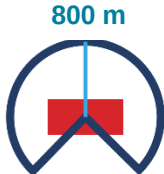


2017



3rd Generation IBIS ArcSAR

First commercial, revolutionary ArcSAR for long range monitoring in every geometry and situation.
第一个商用的、革命性的ArcSAR用于几何和位置的远程监控。



2018

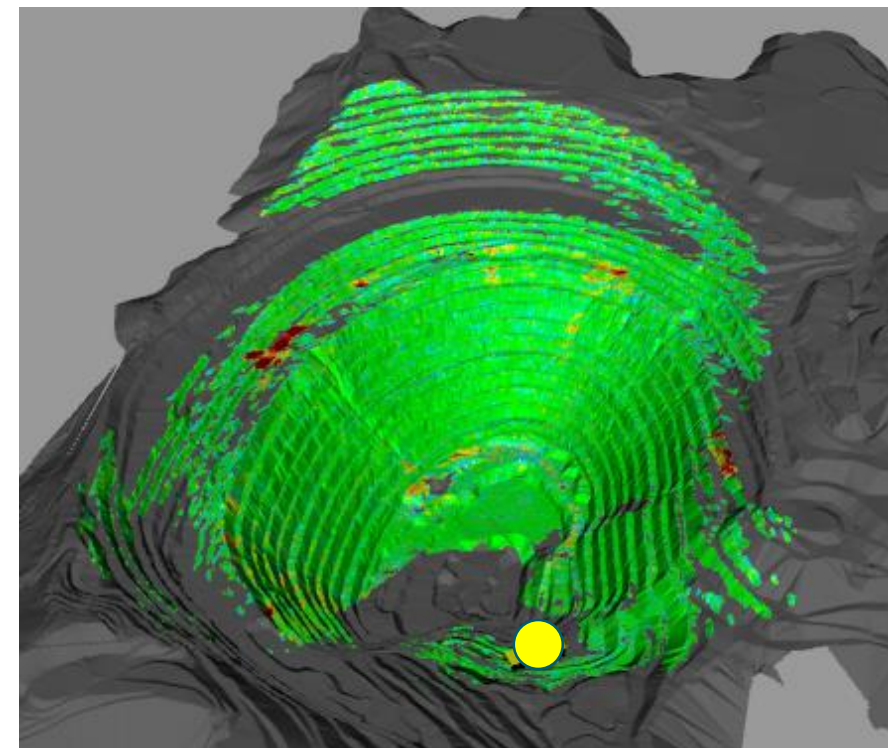
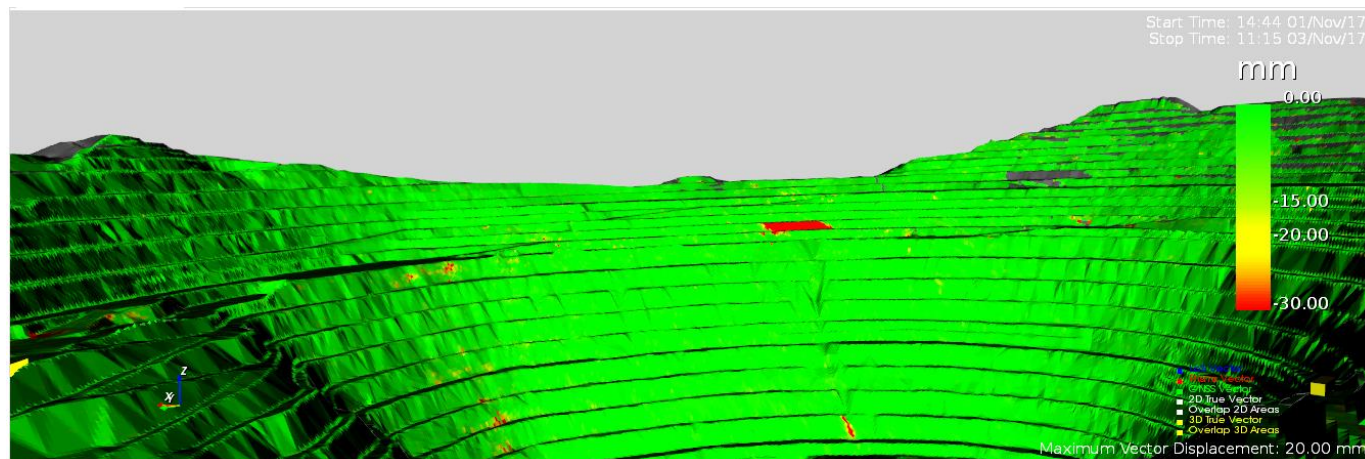


HYDRA

First compact, portable ArcSAR for short range, focused monitoring in Open Pit and Underground mines
第一款小型便携式短距ArcSAR，集中监测露天矿和地下矿山。

Unmatched performance in Open Pit Mine monitoring and early warning

露天矿监测预警性能无与伦比

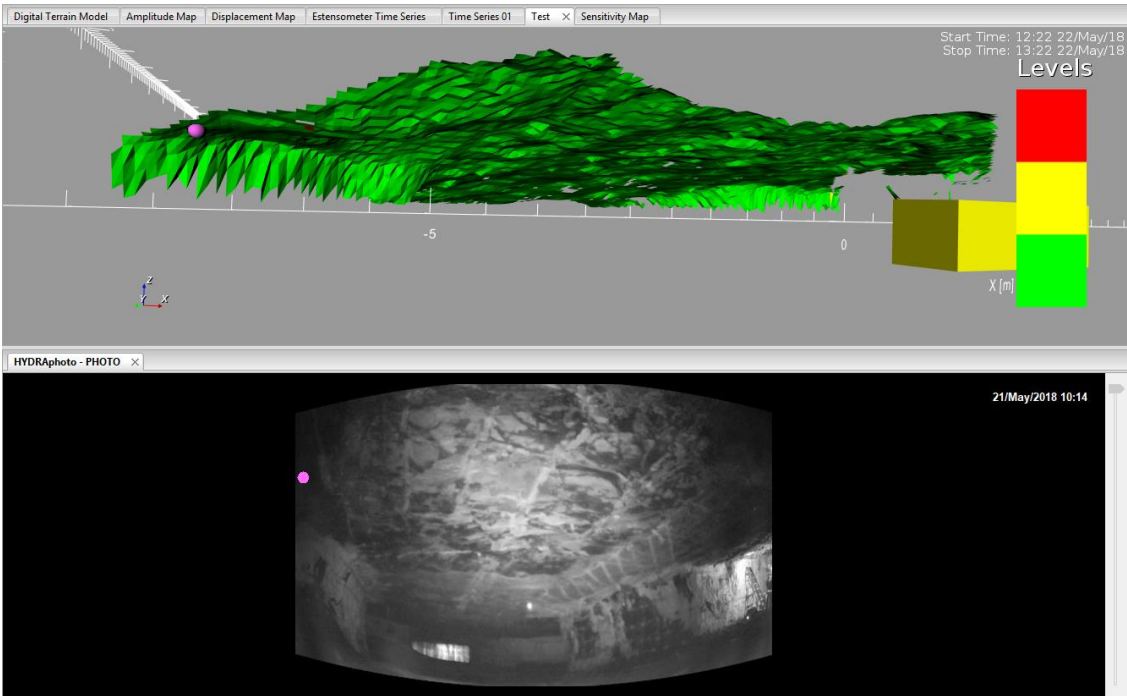
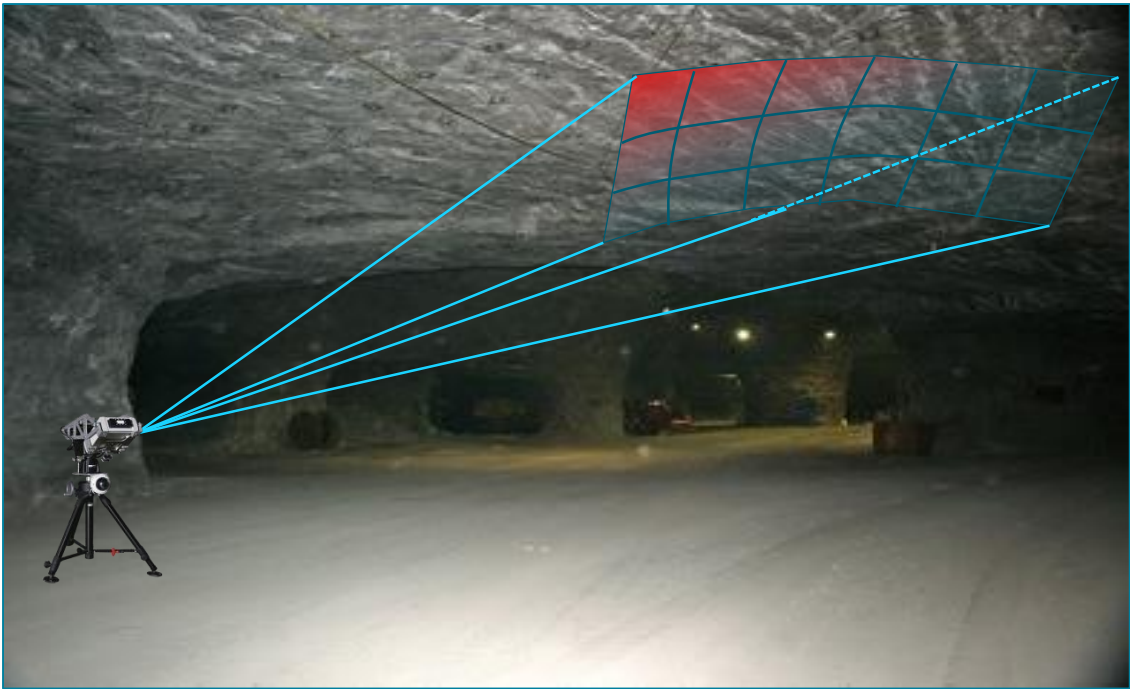


IBIS ArcSAR:

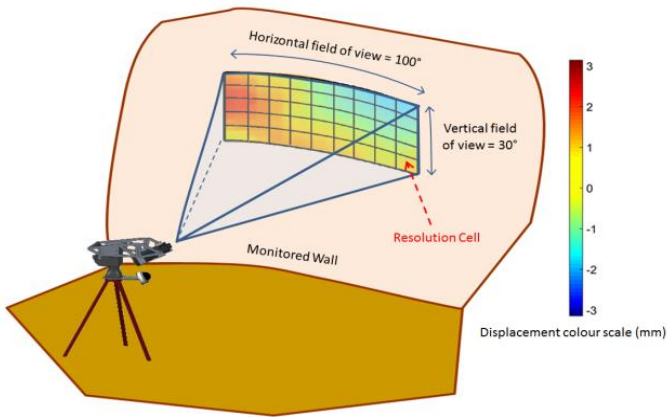
- 360° azimuth coverage 360° 全方位覆盖
- 5 km range 5km距离
- Highest spatial resolution in the market 市面最高空间分辨率
- Integrated panoramic camera 集成全景相机

Hydra-U: the first Radar for underground mine stability monitoring

Hydra-U:首个用于井下稳定性监测的雷达



Distance距离 (m)	Resolution cell 分辨率(m)
10	0.2 x 0.08
50	0.2 x 0.4
100	0.2 x 0.8
200	0.2 x 1.6



—— 谢 谢 ——

