INNOVATIVE GEOTECHNICAL, STRUCTURAL AND ENVIRONMENTAL MONITORING SOLUTIONS

Sixense Soldata SAS Magyarországi Fióktelepe

Irina Parakhnenko, CEE, Central Asia General Manager

MEASURED DECISIONS FOR BUILT ENVIRONMENTS

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Vision

Transform infrastructures into living assets

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Mission

Offer advanced Technologies & Services to Designers, Builders and Managers to optimise their assets through their life cycles.

SOLDATA

Geotechnical, Structural & Environmental **Instrumentation & Monitoring solutions**

+

Specialized Engineering & Expertise

Software

=

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SIXENSE Group

10 specialised branches

SIXENSE Soldata
Detection and monitoring of soils, structures and environment

SIXENSE Concrete
Expert surveys, management and maintenance of built heritage

SIXENSE Digital
Edition and operation of software

SIXENSE Environment
Consulting and monitoring of noise, vibrations and air quality

SIXENSE Geophysics
Applied onshore and offshore geophysical surveys

SIXENSE Iprs
Corrosion-protection engineering for concrete and steel

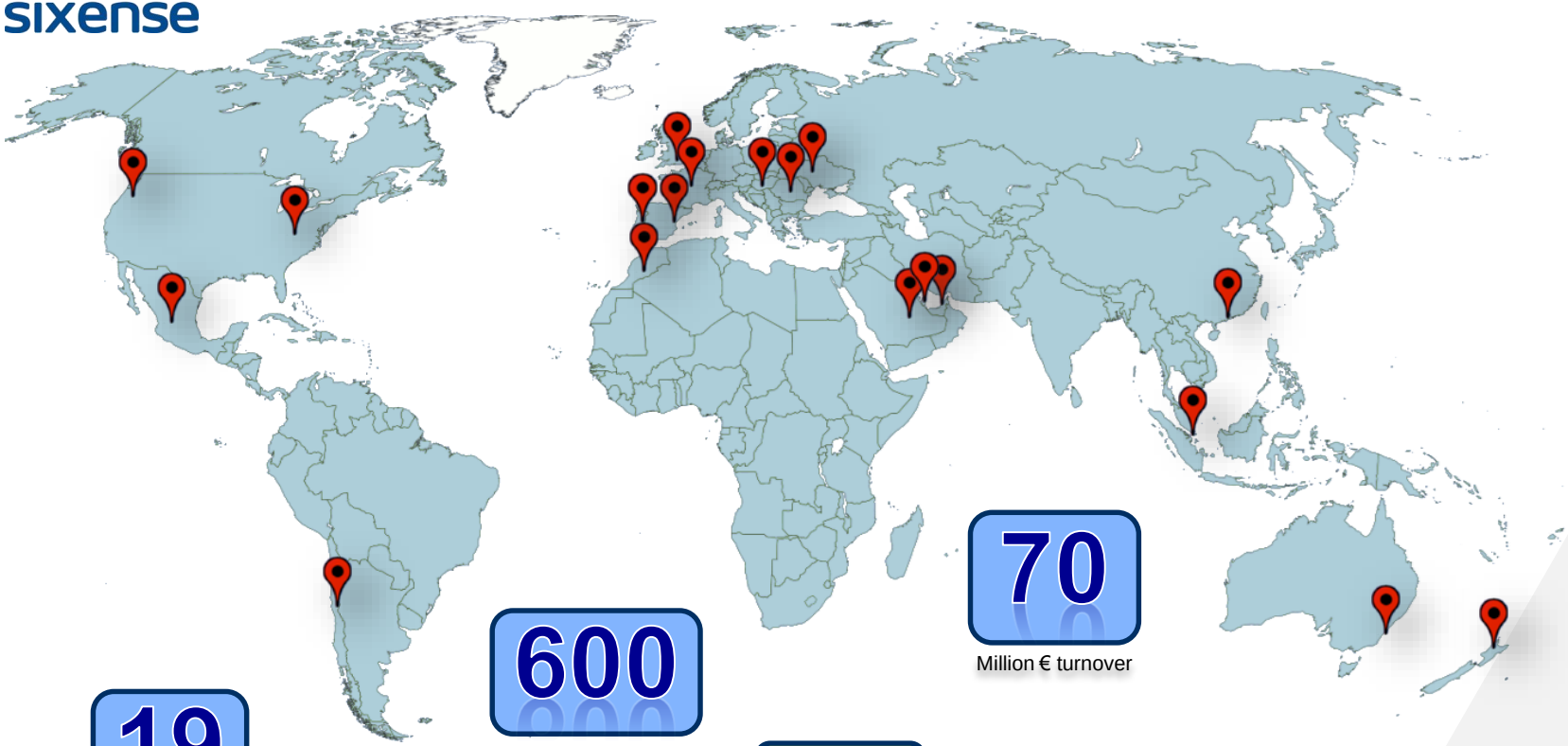
SIXENSE Mapping
Digitalisation and modelling of soils and structures

SIXENSE Necs
Modelling the behavior of material and structures

SIXENSE Systems
Solutions for monitoring and management of infrastructure

SIXENSE In-Situ
Diagnostic, durability, expertise of infrastructure for reinforced concrete

Key figures



19
Subsidiaries + offices

600
Multicultural employees

50%
Out of France

70
Million € turnover

We bring our large experience in Metro and tunnel monitoring projects

- Amsterdam (NL)
- Barcelona (SP)
- London (UK), Crossrail
- Hong-Kong (CH)
- Budapest (HU)
- Lyon (FR)
- Paris (FR)
- Toulon (FR)
- Alaskan Way, Seattle (USA)
- Metro in Rennes (FR)
- Metro in Qatar, Saudi Arabia
- Metro in Guadalajara (Mexico)
- Metro in Kiev (Ukraine)
- Rail link Auckland (NZ)
- Grand Paris Express (FR)
- Metro in Bucharest (RO)
- Tel-Aviv metro (Izrael)
- Etc....

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A. PRELIMINARY PHASE: ELABORATION OF A MONITORING PROGRAM

B. CONSTRUCTION PHASE: MONITORING SOLUTIONS

C. SURFACE DEFORMATION MONITORING STRATEGY

D. DECISION MAKING TOOL AND OBSERVATIONAL METHOD

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"No construction project is risk free.

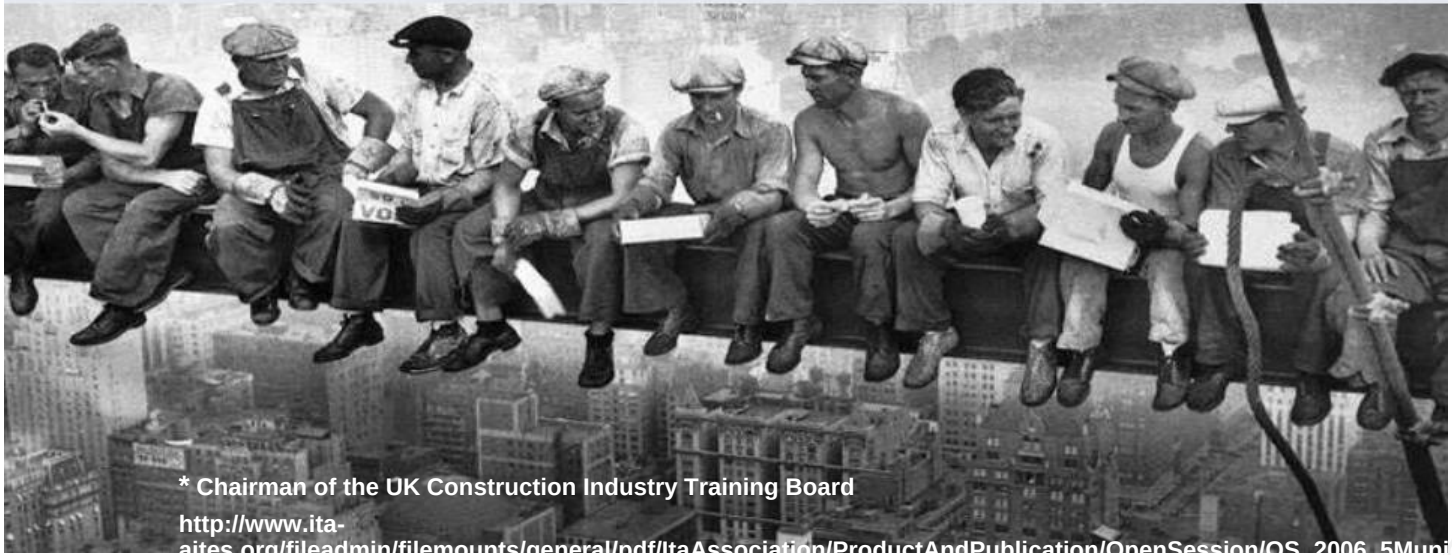
Risk can be managed, minimised,

shared, transferred or accepted.

It cannot be ignored."

Münchener Rück
Munich Re Group

Sir Michael Latham, 1994 *



*** Chairman of the UK Construction Industry Training Board**

http://www.ita-aites.org/fileadmin/filemounts/general/pdf/ItaAssociation/ProductAndPublication/OpenSession/OS_2006_5MunichRe.pd

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- **Key issues during preliminary studies & design stage**

1. **Soil conditions (geological and hydrogeological)**
2. **Environmental impact study**
3. **Evaluate the existing “behaviour” of the city**

Main monitoring program objective :

provide early relevant and reliable information to mitigate the risks

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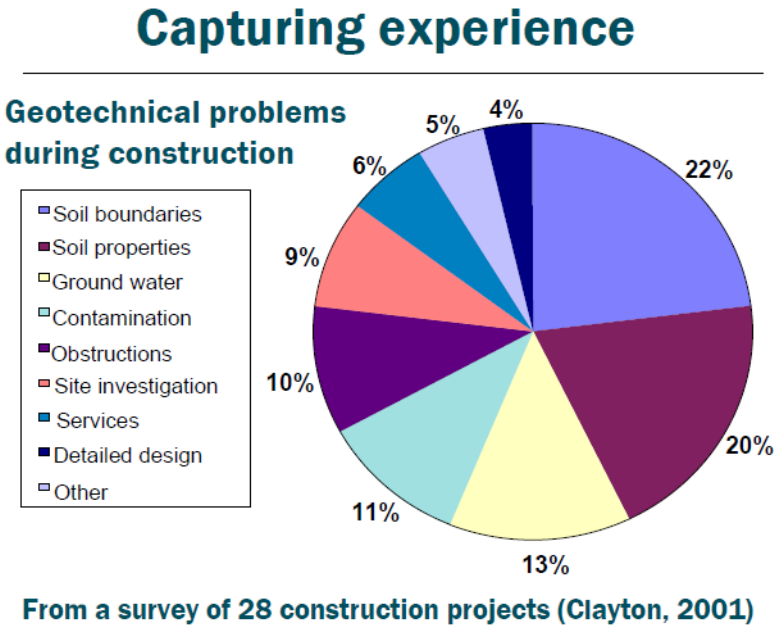
1. Soil conditions (geological and hydrogeological)



Unforeseen geological/hydrogeological conditions represent more than 50% of the geotechnical problems during construction

=> over costs and schedule overruns

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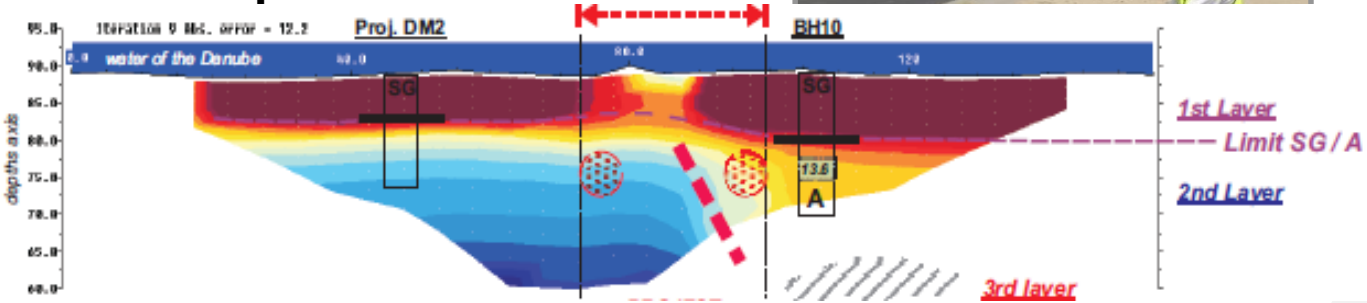
1. Soil conditions (geological and hydrogeological)

Complementary to the geotechnical investigations, the monitoring program shall include geophysical investigations for a better understanding and characterization of the soil conditions such as:

- **Georadar surveys, soil layers & faults**
- **Microgravimetry surveys, natural & art**
- **Electrical panel measurements…**



Electrical panel measurements section under the Danube before Budapest metro line 4 construction

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2. Environmental impact study

Construction project in urban area =
main environmental impact (Noise & Vibration)

The monitoring program shall include :

- **N&V risk assessment impact on the environment to propose mitigation solutions before starting the construction works**

- **N&V measurements (manual and/or automatic) together with management and communication tools during the construction works**

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3. Evaluate the existing state and “behaviour” of the city

Buildings survey

Preliminary study of the settlements using radar satellites

- Full spatial coverage of the whole project
- Point density : 20,000 pts / km²
- < 3mm accuracy

Bucharest metro line 5: Baseline with ATLAS (July-Dec 2011)

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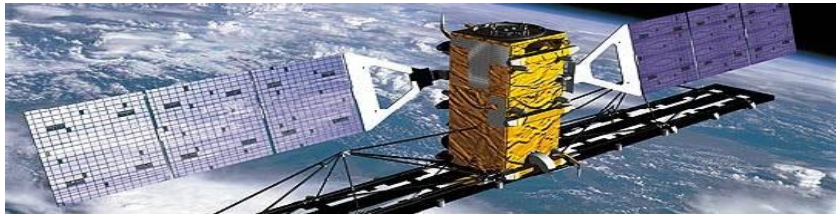
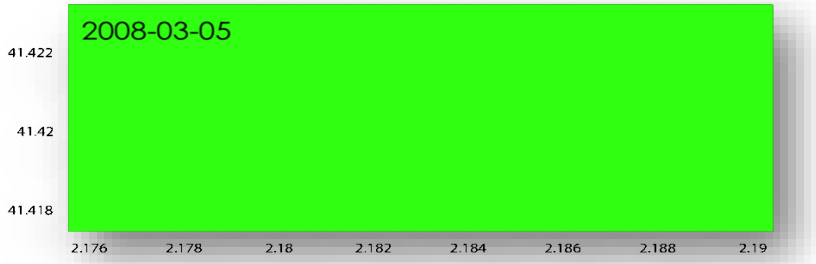
ATLAS : Latest Technique in settlement monitoring

Users benefits

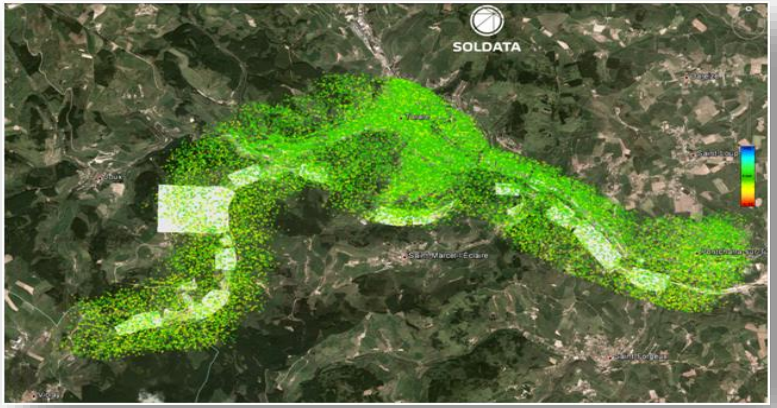
- Work on past images, long term baseline reading
- Large Scale and identification of non « targeted » areas outside ZOI
- Litigation mitigation
- Settlement accuracy < 3mm
- Combination with CYCLOPS Networks
- Up to 20,000 points/km2
- Excellent communication tool
- No installation required





ATLAS:
Landslide monitoring

Landslide prone area of Trans European Motorway



Atlas monitoring of landslide and adjacent area

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Taking the previous aspects into consideration, a detailed monitoring program can be prepared for:

- **3D deformation of the surrounding buildings and structures**
- **Settlement of the roads and pavements**
- **Vertical and horizontal underground displacements of soil layers**
- **Cracks on buildings and structures**
- **Water table elevation and underground pore pressure**
- **Strain in tunnel lining and props**
- **Deformations of the tunnel lining and face**

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Measuring frequency ?

Manual or Real Time ?

Urban tunnels	Number of collapse since 1992	Collapse
No real-time monitoring	17 u / 31 tunnels	54 %
Real-time Monitoring	1 u / 24 tunnels	4 %

- *Study from Munich re-insurance company 1992 – 2006*
- *Cost: few percent of civil engineering construction costs*

In the case of tunnels, the risk of collapse (low frequency of occurrence, heavy consequences) is reduced by a factor of ten using real-time monitoring

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MONITORING SOLUTIONS

Geotechnical sensors:

Inclinometers: D-wall & underground soil deformation in horizontal direction

Extensometers: vertical underground soil layers deformation

Piezometers: underground water level and pore pressure monitoring

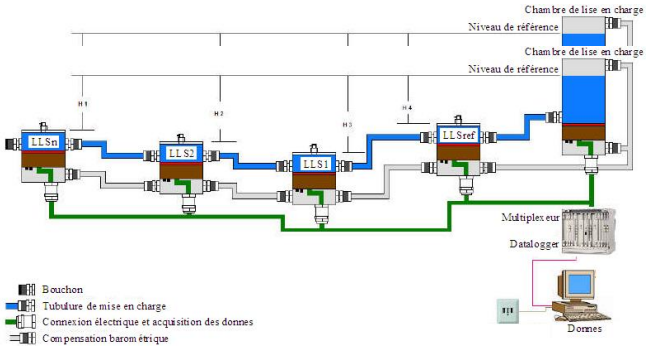
Crackmeters: cracks/joints opening monitoring

Tiltmeters: structures deformation monitoring

Load cells: tie back monitoring

Strain gauges: strain evolution in concrete slabs or in steel props

Liquid Levelling System: Structures settlement monitoring



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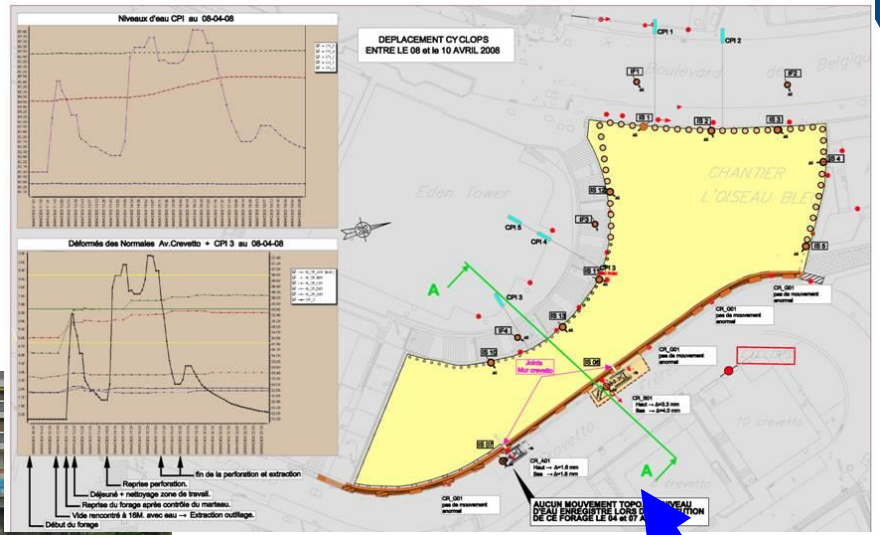
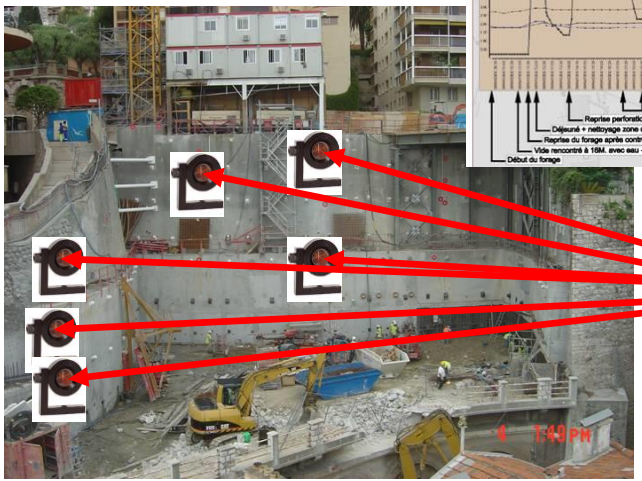
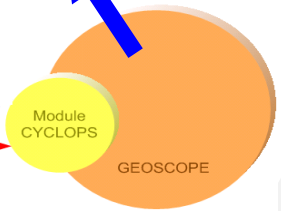
Geodetical systems

CYCLOPS: 3D real time deformation monitoring
Buildings/d-wall deformation
Accuracy: +-1mm X,Y,Z @ 100m
Automatic levelling





Automatic measurements



Automatic acquisition and data processing

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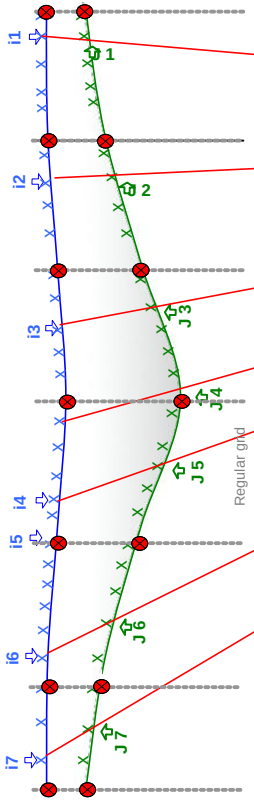
CENTAUR

Reflectorless monitoring technology



centaur

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Unified Environmental monitoring

Noise

Vibrations

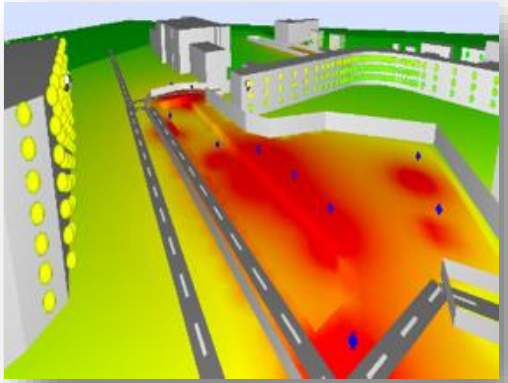
Dust & Air quality

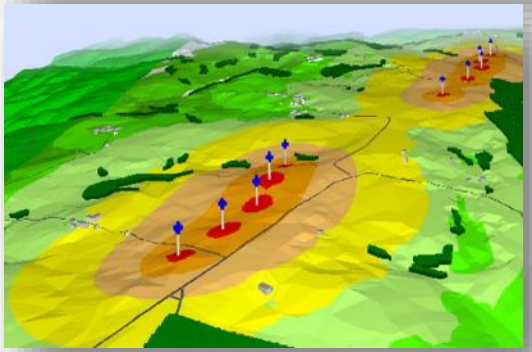
Weather

e-box

Versatile and Integrated environmental monitoring solutions for construction work

Environnmental Expertise





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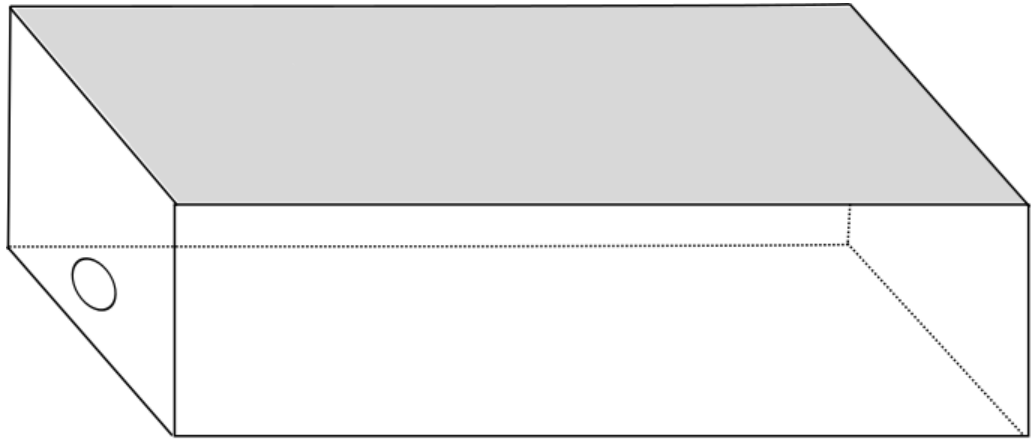
satellite



Before project start get
the map of the reference situation

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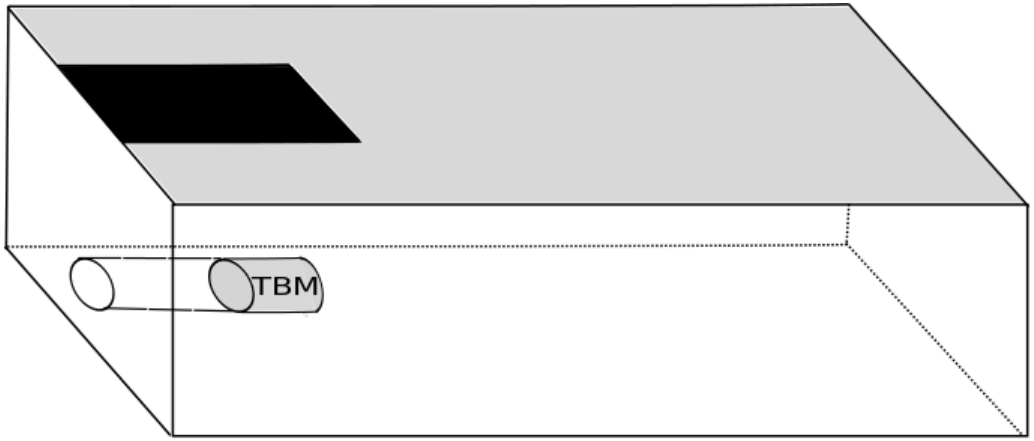
satellite

Adapt the monitoring strategy with project phase



Dense on ground monitoring

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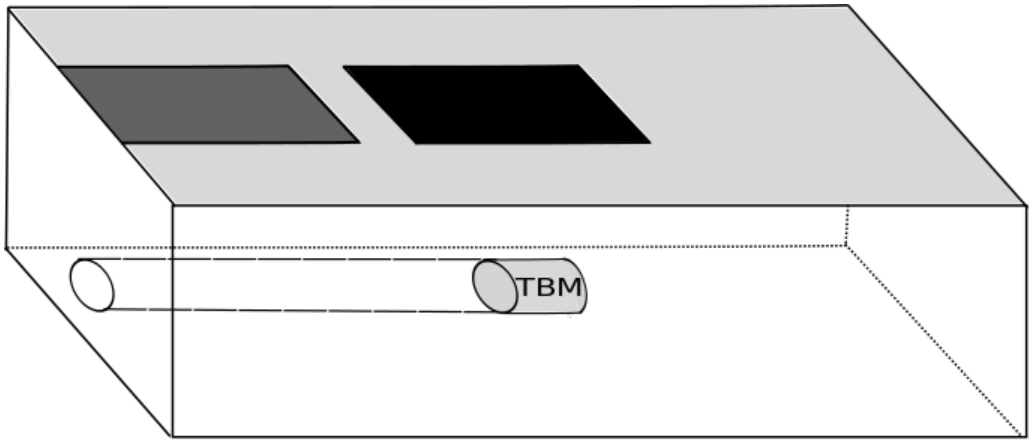
satellite

Adapt the monitoring strategy with project phase



Dense on ground monitoring

lighter on ground monitoring

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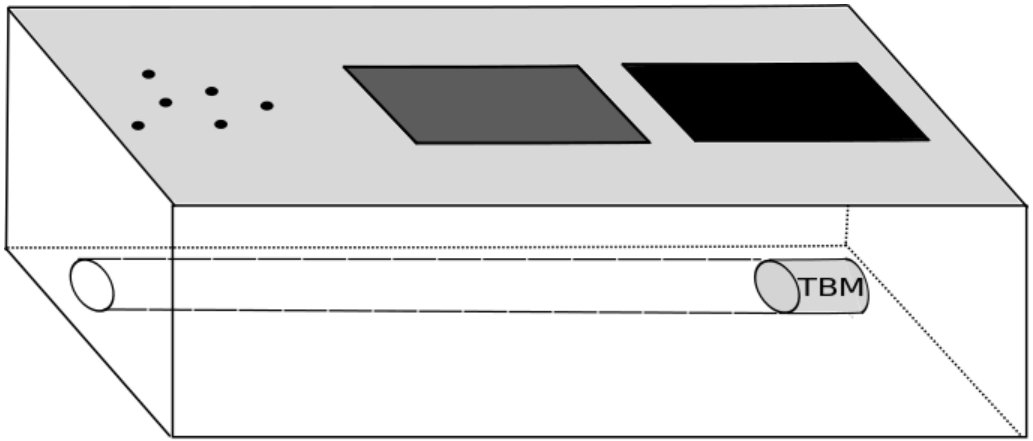
satellite

Adapt the monitoring strategy with project phase



Dense on ground monitoring A+M

lighter on ground monitoring A+ M

Manual on ground monitoring only

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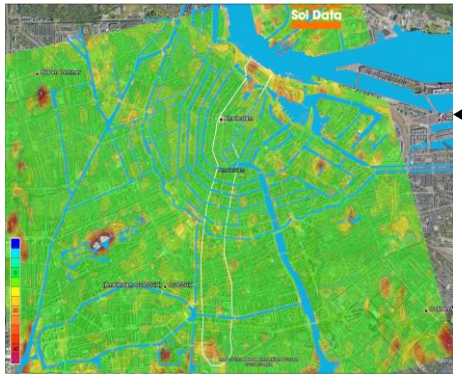
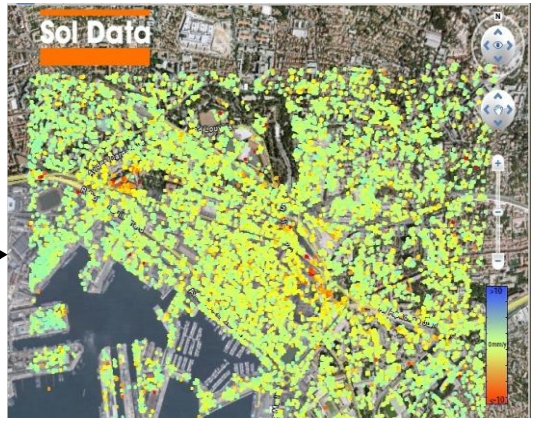
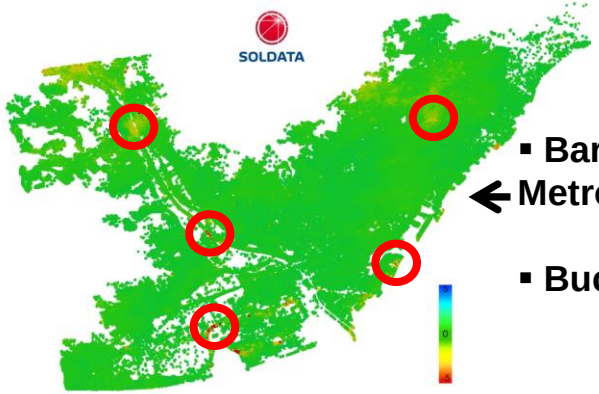
SURFACE DEFORMATION MONITORING STRATEGY



- Amsterdam NZLijn Metro tunnel

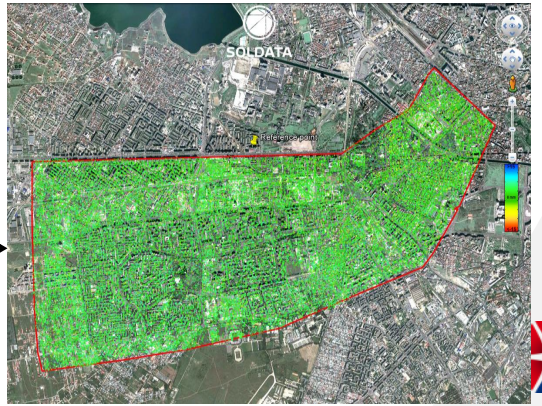
- Toulon A54 motorway tunnel





- Barcelona Metro Linea 9

- Bucarest Metro



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Soldata

Monitoring de travaux urbains

Geoscope

www.sixense-soldata.com

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Geoscope

Real time data management of your construction sites and surroundings.

"Real-time" data processing

Geoscope processes real time monitoring data using a powerful and versatile data reduction engine. Integrating any type of data (automatic sensors, manual readings, environmental instrumentation, total stations, etc.), Geoscope provides advanced data analysis and visualization for simple or complex structures.

Dynamic integration of information

Geoscope is a data hub that dynamically integrates data from third parties in a single source of truth: TBM, roadheader, construction site progression, photos, inspections, reports, CCTV, etc.

Alarm Management

The integrated alarm management module is a powerful feature of Geoscope. A fully configurable system with automatic alarms in real time enabling the optimal monitoring based risk management system.

Specific user interfaces

Each user has specific information requirements and needs. Common features are made available to all users whilst specific interfaces can be configured to individual users' needs to provide them with the most relevant information.

4D and Contour Lines

Advanced graphical representations help understand geological and structural status and behaviour.

Cloud, Desktop and Mobile Solutions

Take Geoscope with you anywhere: in addition to the full desktop version, your data is available on tablets and smartphones.

Risk Mitigation

Geoscope is a decision-making tool for mitigating geotechnical, environmental and structural risks linked to construction or site operation.

Less data, more information

Each measurement improves your understanding of each structures' behaviour. Geoscope transforms data into information.

A tailor-made solution

Fully scalable and customizable solutions to meet your needs and the characteristics of your project.

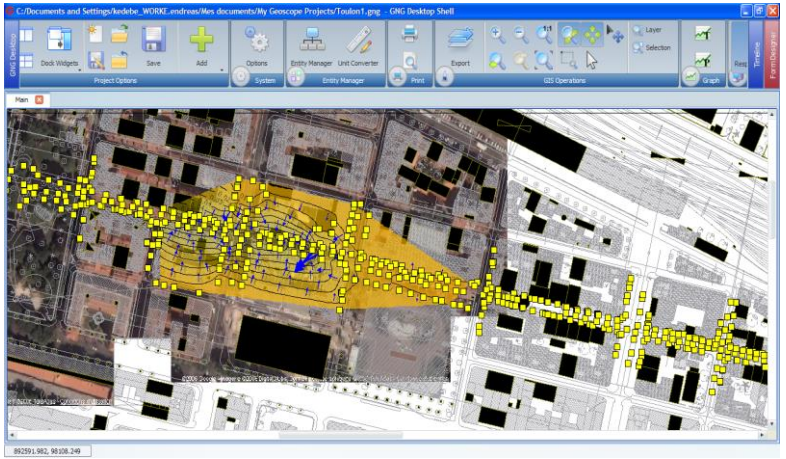
An experienced team at your service

- 20 years' of experience in instrumentation and monitoring
- Extensive knowledge of measurements, civil engineering and geomechanics
- Ability to offer optimized solutions combining the latest and most reliable technologies

Geoscope – WebGIS system

Information platform with GIS interface
Adaptable, integrated and user-friendly

Decision making tool
+ all data are available on one platform
+ whatever the source or the sensor
+ whatever the format
+ dynamic integration of information from third parties
+ real-time data processing using a powerful and versatile data-reduction engine



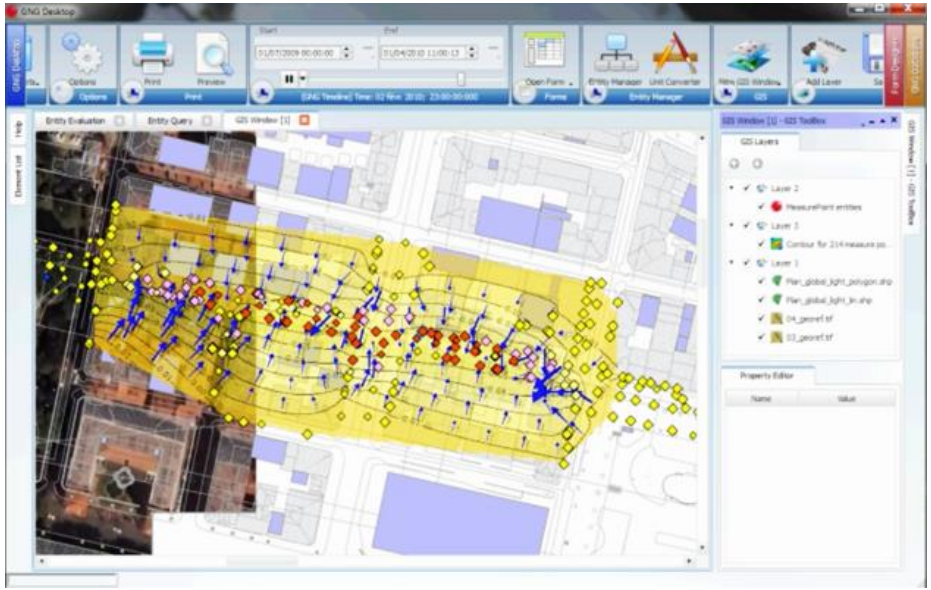
+ Settlement during the construction of the Toulon tunnel

Geoscope – Alarm management

+ Integrated automatic alarm system

Alarm management

+ Project specific alarm levels
+ Multi-levels
+ Automatic alarms by e-mail, SMS, gyrophare etc.



geoscope

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Technologies & know -how

Instrumentation & monitoring

Expertise & Engineering

Digital solutions / software

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Instrumentation & monitoring

Geotechnical

- Inclinometer
- Piezometer
- Extensometer
- Settlement …
- IoT

Environmental

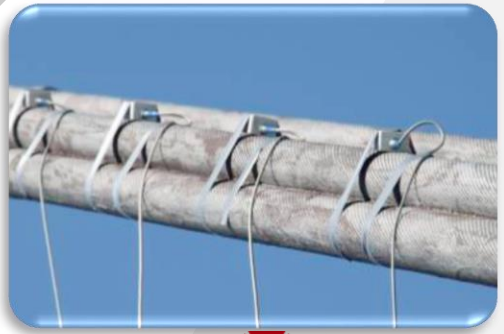
- Noise
- Vibrations
- Dust
- Air quality
- Water quality…

Deformation / Structural

- CYCLOPS / CENTAUR
- ATLAS (satellite)
- Strain gauges
- Load cells …

Specific

- Stay cable
- Pre-stressing tendons
- Post-tensioning bolts/bars …



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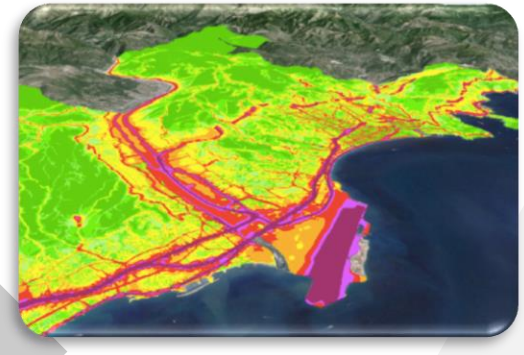
Expertise, diagnostics, engineering

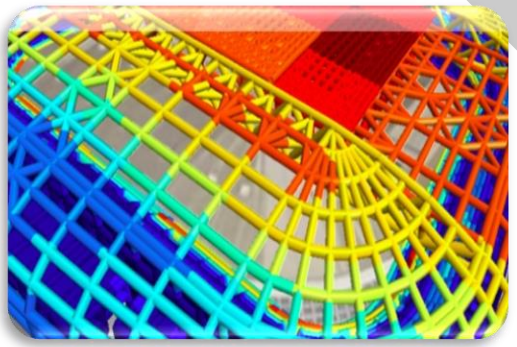
Structure investigation

- Pre-stressing residual tension
- Corrosion
- Concrete stress
- Grouting void

Environmental consultancy

- Impact assessment
- "No claim" value proposition



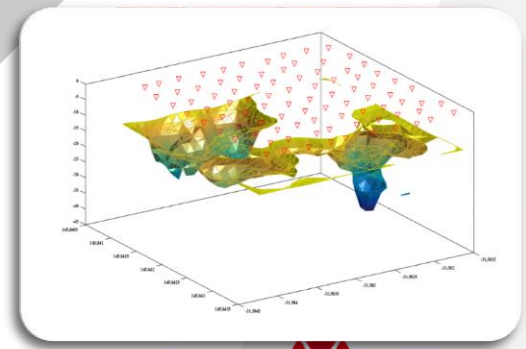


Extreme solicitations

- Structural modelling
- Life expectancy assessment

Geophysical investigations

- S. Less Seismic (3D underground mapping)
- Cavity detection
- Pile/Dwall integrity
- CylJet™



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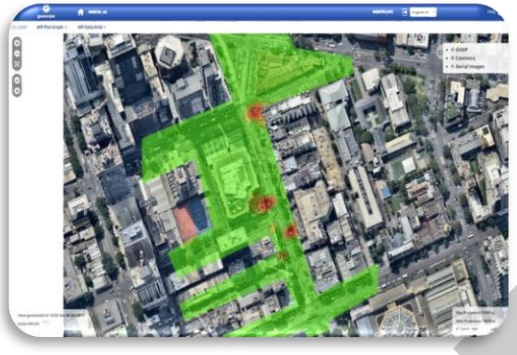
Software & Digital

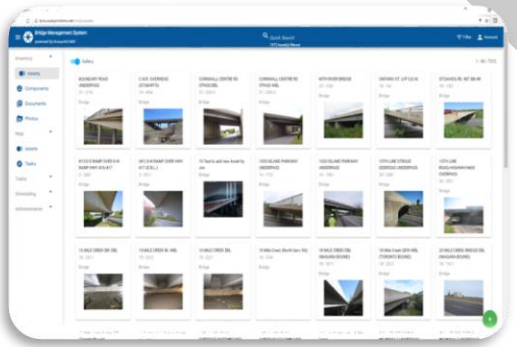


GEOSCOPE

- Data hub; any data, any format
- Real-time processing
- Advanced alarm& reporting module
- PC/ Tablet / mobile

DIGITAL SITE

- **BIM on site**
- Digitalisation of processes
- Electronic Document Management (EDM)



SCANPRINT

- Asset Management
- Inventory
- Inspection &report
- Health assessment
- Optimisation of corrective actions

Mapping

- Asset digitalisation
- Lidar,
- Photogrammetry
- Vectorisation and processing (cross sections, volume..)

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