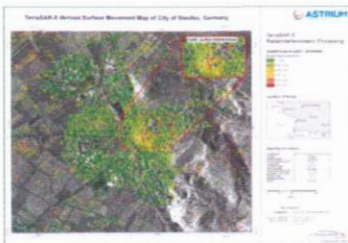


Astrium GEO Information Services' offer includes a detailed analysis of known surface movement phenomena, client-tailored project design integrating accessible ancillary information (e.g. DGPS, levelling, millimeter measurements) and ground installations (e.g. corner reflectors), data acquisition and processing, and the integration and interpretation of results.

Proven production processes and an ISO 9001 certified quality assurance guarantee efficient evaluations and map products.

Clients include major companies from oil- and gas and civil engineering industry as well as public authorities from around the globe. They apply Surface Movement Maps in risk diagnostics, thus minimizing the risks their activities impose not only on buildings and infrastructure, but on human lives as well. Underground production techniques like Enhanced Oil Recovery (EOR) or underground gas storage (natural gas or CO₂) can be monitored and thus optimized.



The evaluation of a TerraSAR-X StripMap data stack clearly documents surface displacements in the city center of the historic City of Staufen in Breisgau in Southern Germany within only four months.

Technical Specifications

Geometric resolution	x, y = up to 1m
Measurement precision (1σ)	Average Displacement Rate < 1 mm / year. Single Measurement 5mm (depending, among others, on atmospheric conditions, point density, number of available datasets)
Update frequency	From 11 days (with TerraSAR-X), according to user requirements
Format of delivery	Point vector data including surface movement rates and related surface movement time series in ESRI Shapefile and MS Excel (other formats upon request)
Type of data delivered	Maps (plots, digital), vector data sets, graphs & tables displaying time series of point displacements
Data sources used	TerraSAR-X, various medium-resolution spaceborne radar sensors



JURUKUR PERUNDING SERVICES SDN BHD
7 Jalan Industri PBP 3, Taman Industri Pusat Bandar Puchong,
47100 Puchong, Selangor Darul Ehsan, Malaysia.
Tel: +603-5623 3228 Fax: +603-8062 2999 e-mail: mapping@jpsurveys.com



ASTRIUM
GEO-Information Services

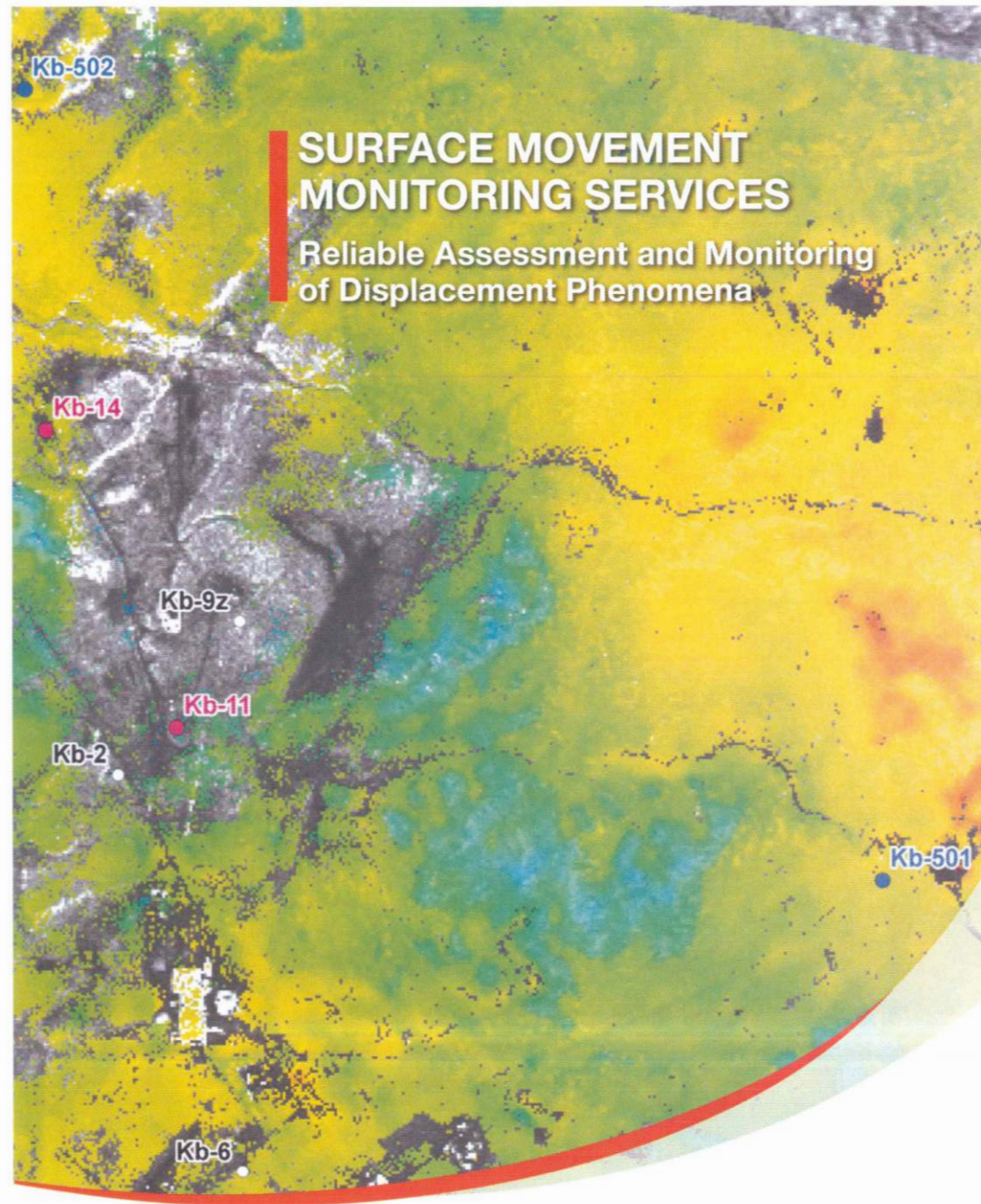
Australia, Brazil, China, France, Germany, Greece, Hungary,
Japan, Singapore, Spain, United Kingdom, United States
E. info@astrium-geo.com

www.astrium-geo.com



SURFACE MOVEMENT MONITORING SERVICES

Reliable Assessment and Monitoring of Displacement Phenomena



Map: © 2009 Astrium GEO-Information Services. All rights reserved. © 2009 Astrium GEO-Information Services. All rights reserved.

All the space you need



Reliable Monitoring of Surface Movement with Millimetre Precision

The damages to buildings caused by subsurface mining, excavations, or underground engineering; the destruction of road or rail networks following landslides; severe ground movements resulting from compaction of reservoirs or stimulation activities in large oilfields - whether caused by man-made activities or natural events: effects can be very sudden and far-reaching, and may endanger infrastructure and even human lives.

Astrium GEO-Information Services' **Surface Movement Monitoring Service** reliably determines surface displacements even in millimetre range: information that is crucial for persons and/or authorities ensuring the security or effective performance of the above-mentioned activities.

Depending on requirements and surface conditions, different technical approaches are chosen, yielding point-wise surface movement information with densities exceeding 10,000 points per square kilometre (under optimum conditions e.g. in urban areas).

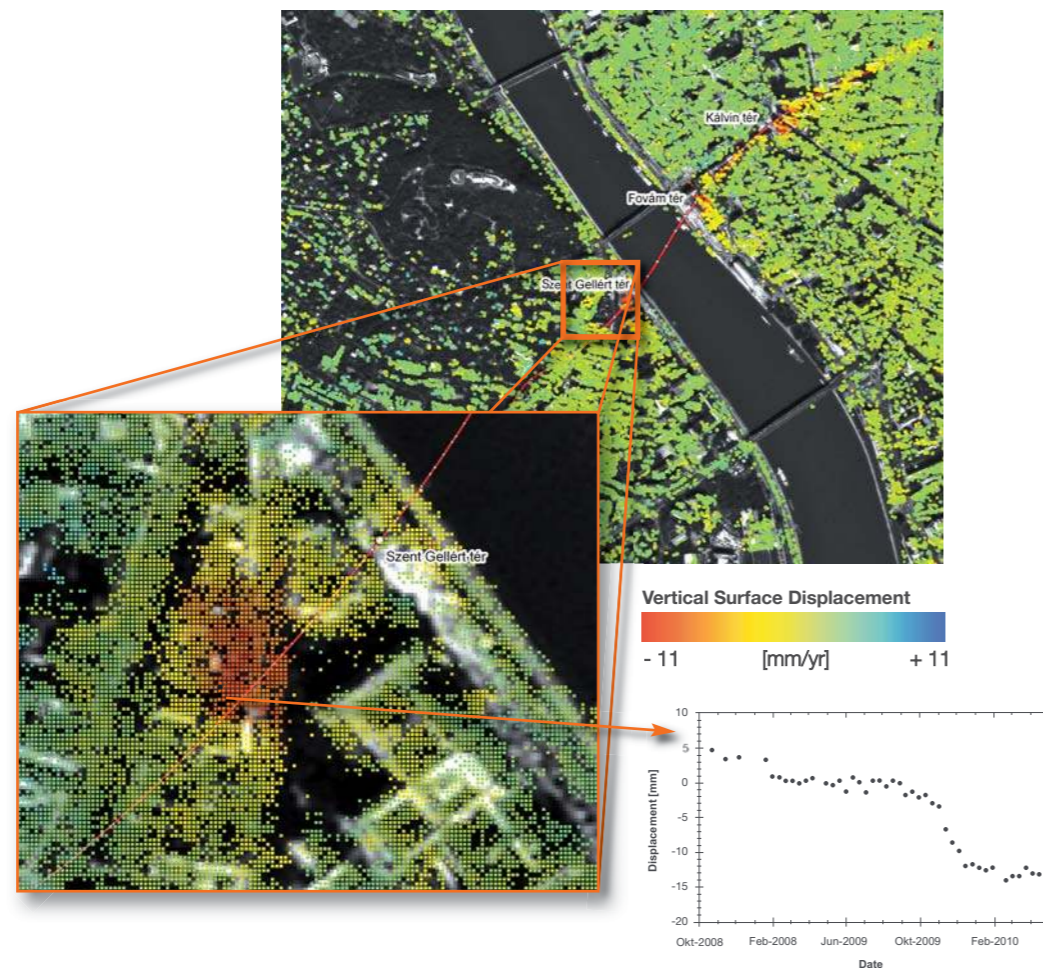
The distribution and density of the measuring points depends on surface conditions. Specific landmarks (e.g. buildings or outcrops) deliver individual points, which are located according to their spatial distribution (e.g. buildings in an urban area). Seamless movement information can be derived if the surface is homogenous and temporarily stable in terms of radar backscatter (e.g. rocky deserts). Information for individual points comprises surface movement rates as well as temporal evolution of surface movements. Artificial corner reflectors can be used in order to establish additional points in areas where no or only sparse "natural" points are available (e.g. in agricultural areas).

To ensure a frequent acquisition of the status and a detailed identification of movements, **high-resolution radar data**, typically acquired by **TerraSAR-X**, is used. It is particularly suitable for monitoring fast changing surface movements with complex and/or small-scale movement patterns, as the satellite can cover the target area as frequently as every 11 days, independent of weather conditions. As Astrium GEO-Information Services holds the exclusive commercial exploitation rights for this satellite, a uniquely dependable data access is guaranteed.

For less frequent updates and lower temporal resolutions (typically monthly repetitions), Astrium GEO-Information Services resorts to **medium-resolution radar data**: various spaceborne radar sensors are suitable to detect and monitor large-scale and / or slow-changing surface movements.

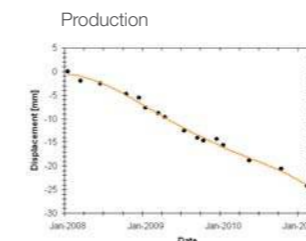
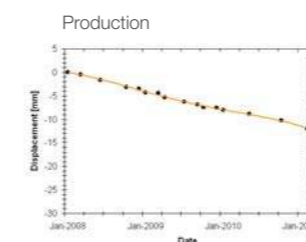
- **Reliable:** weather independent & secured access.
- **Regular:** updates every 11 days possible.
- **Flexible:** processing techniques adaptable to surface conditions.

Urban Monitoring



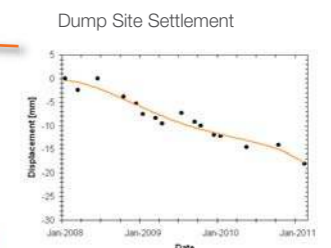
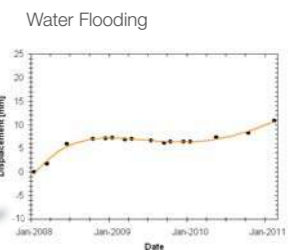
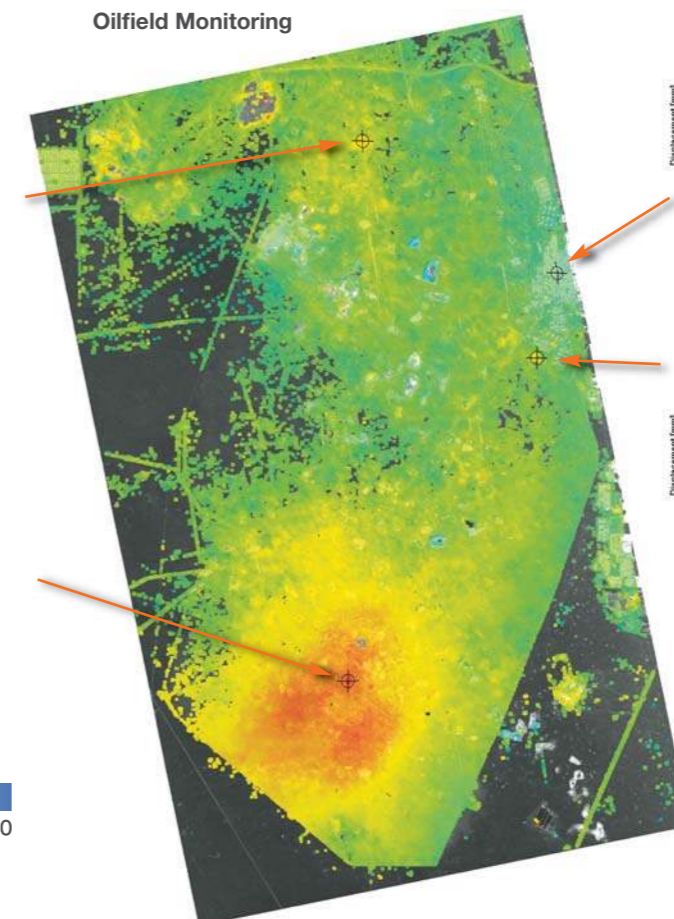
Surface movement monitoring at a subway construction site in Budapest (Hungary) documents tunneling-related surface displacement for a large number of points. Further, highly non-linear signals related to specific tunneling activities have been resolved.

Oilfield Monitoring



Vertical Surface Displacement [mm/yr]

- 10 [mm/yr] + 10



Wide-area monitoring of oil production-related surface movements at Burghan oilfield, the largest oilfield in Kuwait, identifies surface displacements related to different activities.