



Astrium Services

TERRASAR-X SERVICES

Radar Satellite Services of Unique
Precision, Quality and Reliability

Together pioneering excellence



TerraSAR-X Mission & Astrium GEO-Information Services

TerraSAR-X is the first German radar satellite built in a Public Private Partnership (PPP) between the German Aerospace Centre (DLR) and Europe's leading satellite system specialist EADS Astrium GmbH. The commercial marketing of TerraSAR-X data and services is conducted by Infoterra GmbH, the German Astrium GEO-Information Services part, exclusively.

TerraSAR-X has been specifically designed to meet the requirements of commercial users worldwide. In addition to high-resolution **radar satellite data**, a variety of **geo-information products and services** complete the portfolio: Astrium GEO-Information Services provides reliable and timely knowledge to customers in versatile fields of application around the globe.

The reliable and efficient distribution of TerraSAR-X Services across all continents is ensured by an extensive **global partner network**. Customers benefit from the distinct local knowledge and experience of these partners, which respond directly to the specific and varying regional needs.

The exclusive TerraSAR-X **Direct Access Service** is the fastest way to obtain radar imagery anywhere on the globe: the data can be received directly from the spacecraft at a local ground station operated by Astrium's Direct Access Partners.

The company's portfolio will be enhanced even further with the launch of **TanDEM-X**, a second, almost identical twin satellite designed to fly in a close formation with TerraSAR-X. Together, the two satellites will collect interferometric data pairs for the generation of a homogeneous global Digital Elevation Model (DEM) of an unprecedented quality, accuracy and coverage.

Astrium GEO-Information Services is a recognised world leader in the geo-information market, offering decision-makers sustainable solutions to increase security, protect the environment, and better manage natural resources.

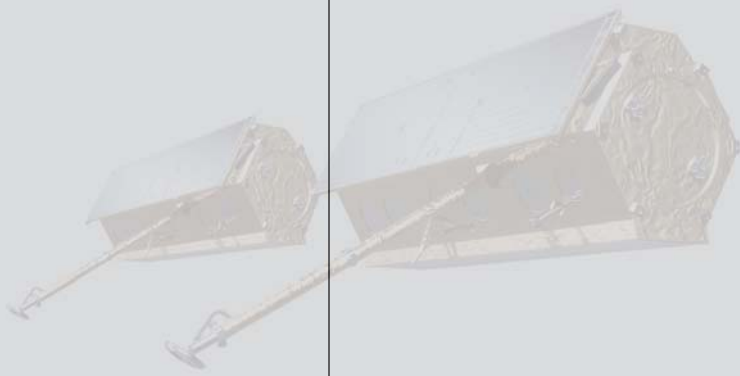
Taking full advantage of the resources and skills offered by Spot Image and Infoterra, this Division of Astrium Services has exclusive access to SPOT and TerraSAR-X satellite data while also calling on a full gamut of space data sources and airborne acquisition capabilities, enabling it to offer an unrivalled combination of Earth observation products and services.

By building on the synergy of Astrium Services, the GEO-Information division can also develop innovative solutions combining Earth observation, navigation and communication applications at competitive prices.



- Resolution up to 1 m
- Geometric accuracy unrivalled by any other commercial spaceborne sensor today
- Excellent radiometric accuracy
- Weather-independent site access time of 2.5 days max. (2 days at 95% probability) to any point on Earth.
- Unique agility (rapid switches between imaging modes and polarisations).

TerraSAR-X High-Resolution
Spotlight Acquisition
(1-m resolution)
of Vancouver, Canada.



TerraSAR-X Radar Imagery

Astrium GEO-Information Services offers an extensive portfolio of high-quality TerraSAR-X radar imagery products that can be individually specified according to user needs and requirements;



Basic Image Products

TerraSAR-X basic image products can be acquired in one of these main Image Modes:

- **High-Resolution SpotLight:** up to 1-m resolution, scene size 5 to 10 km (width) x 5 km (length);
- **SpotLight:** up to 2-m resolution, scene size 10 km (width) x 10 km (length);
- **StripMap:** up to 3-m resolution, scene size 30 km (width) x 50 km (length*);
- **ScanSAR:** up to 18-m resolution, scene size 100 km (width) x 150 km (length*).

The unique design of TerraSAR-X's SAR antenna enables a variety of **polarimetric combinations:** single or dual polarisation and even full polarimetric data takes are possible.

Further, four **Product Types (Processing Levels)** are optionally selectable with each acquisition:

- **Single Look Slant Range Complex [SSC]:** a single look product of the focused radar signal, data being represented as complex numbers containing amplitude and phase information.
- **Multi-Look Ground Range Detected [MGD]:** a multi-look detected product with reduced speckle and approximately square resolution cells; image coordinates are oriented along flight direction and along ground range.

- **Geocoded Ellipsoid Corrected [GEC]:** a multi-look detected product, resampled and projected to the WGS84 reference ellipsoid assuming one average height.
- **Enhanced Ellipsoid Corrected [EEC]:** an orthorectified multi-look detected product in which image distortions caused by varying terrain height are compensated using a globally available DEM.

Enhanced Image Products

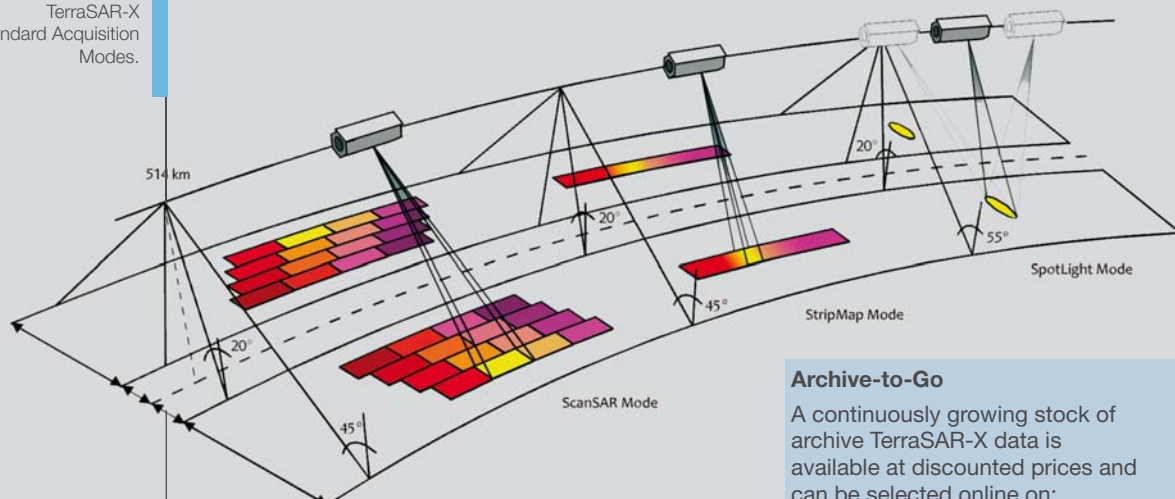
Value-adding processes, applied to basic imagery, create the enhanced image products.

- **Orthorectified Images** feature an improved pixel location accuracy based upon the integration of external high-quality DEMs.
- **Radiometrically Corrected Images** are additionally refined to enable an improved interpretation of object characteristics independent of their topographic position.
- **Radar Mosaics** are a seamless assembly of adjacent images into a single, harmonised dataset.
- **Ascending-Descending Merges** feature a significant reduction of the impacts of side-looking effects such as shadowing and layover.

For each of these products, **customisation services** such as reprojection, reformatting, rescaling, subset generation or the delivery in standard map layouts are optionally available.

**StripMap & ScanSAR: scene length extendable to up to 1,650 km.*

TerraSAR-X Standard Acquisition Modes.



Archive-to-Go

A continuously growing stock of archive TerraSAR-X data is available at discounted prices and can be selected online on: <http://terrasar-x-archive.infoterra.de/>.



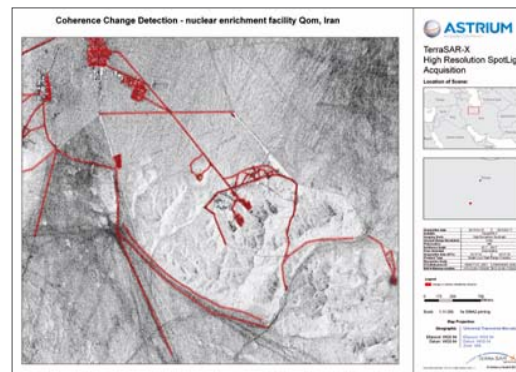
TerraSAR-X-based Geo-Information Services

Based on TerraSAR-X as a unique data source, Astrium's geo-information experts offer a variety of products and services. These include well-established radar-based services, now significantly enhanced and improved thanks to TerraSAR-X's novel features, as well as an innovative usage of the radar satellite data.

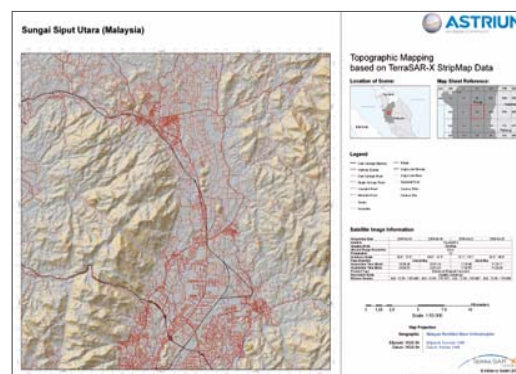
Change Detection Maps

contain information on changes on the Earth's surface, obtained by comparing recent TerraSAR-X acquisitions to older data collected by this or other sensors. Amplitude change detection as well as coherence change detection methodologies are applied.

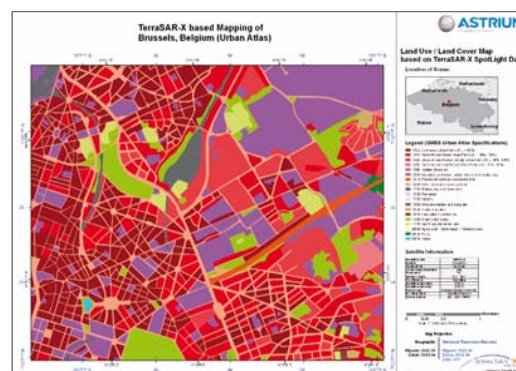
- **Rapid Assessments** support the quick evaluation of changes that occur at one specific point in time (e.g. impacts of major accidents or natural disasters) by comparing pre- and post-event data.
- **Site Monitoring Services** are time series of acquisitions to regularly monitor e.g. construction sites, urban development, natural phenomena such as volcanoes, or points of interest for intelligence purposes, documenting developments over a period of time.



Monitoring of nuclear facilities near Qom, Iran: TerraSAR-X radar data unveils significant activities and changes in and around the site.



Topographic Map based on TerraSAR-X StripMap data (top), and displayed as a shaded relief containing Contour Lines and Linear Features (bottom), Sungai Siput Utara, Malaysia.



High-Resolution Land Cover Map of Brussels, Belgium, based on a TerraSAR-X SpotLight acquisition.

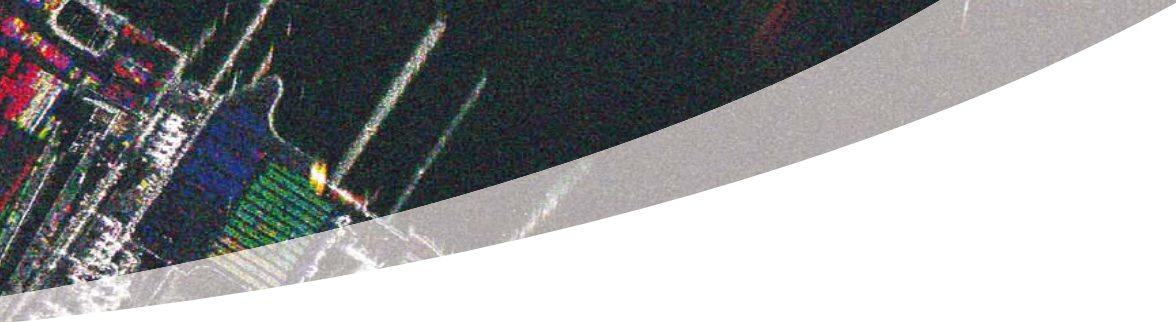
Topographic Maps

are essential instruments for a variety of monitoring and planning activities. Reliable mapping and regular updates of existing topographic maps ensure up-to-date decision making. Particularly in regions often covered by clouds, the use of radar imagery is a cost and time-efficient base mapping approach – an innovative and competitive alternative to today's methodologies.

In **unique project concepts**, reliable and precise topographic mapping at scales 1:50 000 to 1:25 000 for variable project sizes is conducted. Up to 60 different feature classes can be extracted from the basic radar image, elevation data is optionally available. First map sheets become available within weeks after project start. Projects can be reliably designed to time constraints and budget lines, and Astrium usually relies on national in-country mapping expertise in the course of such projects.

Land Use / Land Cover Maps

are an essential input to a variety of geo-information applications, particularly for public authorities and planning bodies. TerraSAR-X data are the base for reliable and cost-efficient Land Cover Mapping Services, harmonized across borders, at different thematic and spatial resolutions, either as individual client-specific solutions or as standardised products responding to today's prevalent needs.

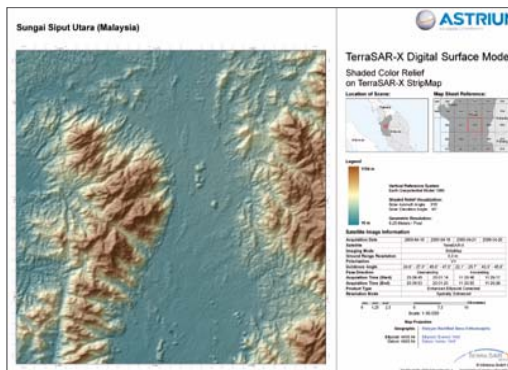


Digital Surface Models (DSM)

are generated applying radargrammetry techniques to TerraSAR-X radar data pairs acquired in two coverages from two different view angles. The very-high geometric accuracy of TerraSAR-X and the parallax displacement achieved by using different viewing angles results in positional and height accuracies of up to 5 m.

As both orbit and altitude of the satellite are precisely known, TerraSAR-X, unlike any alternative (airborne or optical spaceborne) acquisition method available today, achieves this accuracy **without requiring ground control points** as references.

Further editing of the DSMs into Digital Terrain Models (DTMs) that represent the bare surface of the Earth is possible. Within the TanDEM-X Mission, an even more precise global DSM will become available.



TerraSAR-X based Digital Elevation Model, Sungai Siput Utara, Malaysia.

Surface Movement Maps

document surface displacement even in the range of millimetres. Regularly monitored, this information is crucial for effective, reliable risk diagnostics, e.g. in oil/gas production, natural gas or CO₂ storage or mining applications.

TerraSAR-X radar data enables a flexible adaptation of processing techniques to prevailing surface conditions:

- **2D Surface Movement Maps** are created applying Differential Interferometry SAR (DInSAR) in areas with no or sparse vegetation or areas with dense infrastructure.
- **Point-Related Surface Movement Maps** are typically used for assessing areas with dense vegetation cover: Persistent Scatterer Interferometry (PSI) is performed on radar backscattering landmarks (e.g. buildings or cliffs).



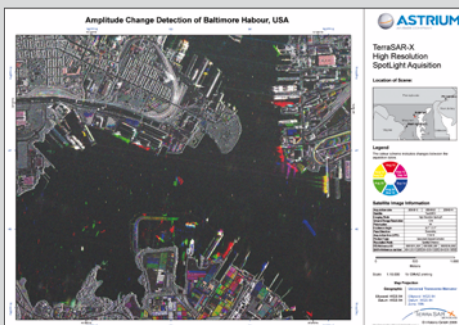
This TerraSAR-X-based surface movement assessment performed during the construction of a new underground line in Budapest, Hungary documents significant surface displacements of up to approx. 10 mm per year along the new track.

Versatile Radar Applications

Earth Observation using spaceborne radar imagery was strongly focussed on scientific purposes in the past. The TerraSAR-X Mission marks an important step towards an increased use of radar satellite data and derived geo-information in a variety of commercial applications. These benefit strongly from the unique TerraSAR-X capabilities.

Fast - Agile - Very High Res: Serving Intelligence and Emergency Response

TerraSAR-X features an unprecedented, unique agility: it is possible to switch between its three different modes and various polarisations within seconds, corresponding to only minor surface acquisition gaps. Data can be downloaded to ground stations – fixed or mobile – around the globe, thus enabling a near-real time data acquisition. The satellite's very high resolution, its high accuracy, the weather and daylight independence, and its quick site access time make TerraSAR-X an ideal sensor to support sensitive decision making in time-critical situations.



Amplitude Change Detection performed on Baltimore Harbour (USA) using three TerraSAR-X HighResolution SpotLight acquisitions (1-m resolution). The traffic of ships as well as vehicles on land is clearly documented.

Intelligence and reconnaissance authorities as well as humanitarian aid organisations appreciate the combination of very high-resolution data and timely data acquisition. While these institutions usually resort to data acquired by optical sensors – often a lengthy operation – TerraSAR-X's complementary near-real time data acquisition capabilities offer a whole new approach to the use of spaceborne data.

The TerraSAR-X customer service and technical teams are available 24/7 to process and evaluate the latest acquisitions whenever rapid mapping activities are required – e.g. following natural or man-made disasters. Accurate and up-to-date maps support crisis response during the actual disaster situation, as well as follow-up responsibilities of insurance services and liability / reinsurance businesses.

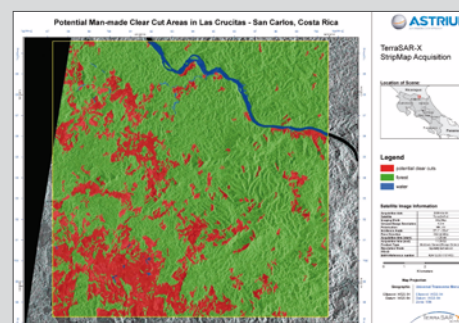
Multi-scale - Multi-polarised - Multi-Temporal: Valuable Input for Environment Protection

The reliable, affordable and cost-efficient information derived from TerraSAR-X data serves as a basis for targeted analysis and improved management of our environment. Around the globe, authorities charged with the sustainable planning and successful management of e.g. water bodies and ground waters, forests, soils and other nature protection activities rely on this information in their everyday work environment.

TerraSAR-X delivers multi-scale, multi-temporal and multi-polarised observations of remote or cloud-covered areas that were formerly almost impossible to map. Detailed monitoring of developments and sound planning become possible even for remote or very large areas.

The wide swath can be used for large-area assessments, while recognition of small-scale issues is enabled by the high spatial resolution, as well as multi-temporal and multi-polarisation observations.

Particularly in tropical regions with frequent cloud cover, TerraSAR-X is a unique tool to monitor endangered areas with unprecedented quality and detail, for example within the international REDD (Reducing Emissions from Deforestation and Forest Degradation) initiative and other tropical forest inventories, ranging from international down to regional scales.



Man-made clearcut areas (red) in the rainforest of Las Cruces, San Carlos (Costa Rica), identified in a TerraSAR-X StripMap acquisition of 6-m resolution.

SAR experts teach interpretation & analysis

While SAR data is uniquely reliable and bears a wide spectrum of informational content, the extraction of this information is not always easy.

In order to acquaint users with the benefits, advantages and usefulness of radar data in general and TerraSAR-X data in particular, Astrium GEO-Information Services offers sophisticated SAR application training courses.

These courses, differing in their level of detail and degree of difficulty, enable a capable application of high-resolution radar imagery and products.





Artist's view of the satellite twins TerraSAR-X and TanDEM-X in space.

TanDEM-X: The World in 3D

With TanDEM-X (TerraSAR-X Add-On for Digital Elevation Measurement), **an additional radar satellite now circles the Earth** in a unique satellite constellation with TerraSAR-X. In a formation flight at distances of a few kilometres down to less than 200 metres, the “twins” will synchronously record StripMap interferometric pairs: the data basis for a global Digital Elevation Model (DEM) of an unprecedented quality, accuracy and coverage.

This **homogeneous DEM** will be available for the Earth's complete land surface, i.e. 150 million square kilometres. The key feature is its relative vertical accuracy of even better than 2 metres (<10 metres absolute accuracy) within a horizontal point distance of 12 metres.

The worldwide homogeneous data acquisition guarantees a global elevation model with no inconsistencies along borders or other administrative boundaries, and no heterogeneities caused by differing measurement processes or reference systems. The accuracy will surpass that of any satellite-based elevation model available today and will even reach a quality level comparable to those achieved using airborne sensors.

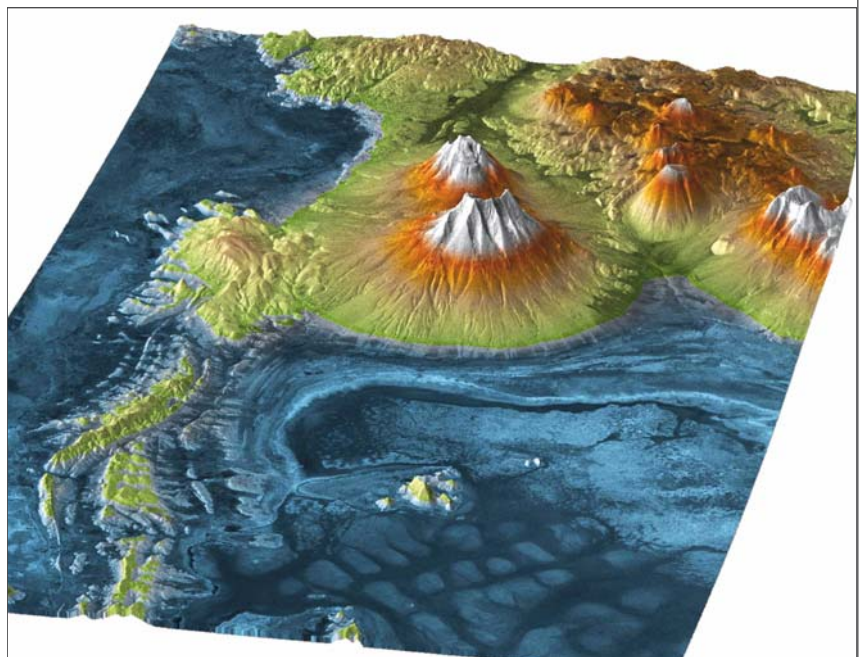
Like TerraSAR-X, this new German satellite mission is carried out as a Public Private Partnership (PPP) between DLR and Astrium. Astrium's GEO-Information Services Division will conduct the commercial marketing of this unique DEM.

The **TanDEM-X Global DEM will be available through Astrium GEO-Information Services**. The Digital Surface Model will be edited in accordance with the international standards of height information. If requested by the customer, **additional refinements to create Digital Terrain Models** (i.e. a representation of the Earth's bare surface) can be performed. Delivery in any established format as well as a thorough ISO:9001-certified quality assurance are guaranteed for all products and services provided.

The applications are manifold, ranging from the precise orthorectification of remote sensing imagery and the availability of solid reference data for rapid response evaluations in crisis situations, through the support of oil and gas field management and an enhanced surface motion monitoring, all the way to a more targeted preparation of defence and security-related missions.

Primarily, however, cartographic authorities around the globe are looking forward to **increasing the precision of height information** within standard cartographic maps thanks to this more accurate and up-to-date data source.

TanDEM-X Digital Elevation Model of the Tunupa volcano and the edges of the salt lake Salar de Uyuni in Bolivia. ©DLR



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