

# **TERRASAR-X MISSION: THE NEW GENERATION IN HIGH RESOLUTION SATELLITES**

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While radar based Earth observation from space in the past was mainly focused on scientific purposes, today data and the derived information products are increasingly used for various commercial applications. From a users' point of view, the data and information supplied by past satellite missions had one considerable drawback: they only partially met their requirements. They had to be more accurate, had to have a better thematic accuracy, and had to be delivered faster and reliably independent of weather conditions and cloud coverage. The data supplied by the new TerraSAR-X mission are the ideal source to meet the today's user expectations.

TerraSAR-X is a German remote sensing satellite program which is the first commercially available radar satellite - cloud independent - to offer up to one meter resolution. TerraSAR-X was successfully launched on the 15<sup>th</sup> of June 2007 and it was a coincidence that the first TerraSAR-X image was taken on the 19<sup>th</sup> of June over Russia (Tsimlyanskoye reservoir, ca. 50 km west of Volgograd). After half a year of commissioning phase the data are commercially available since January 2008.

The satellite is mainly described by:

- TerraSAR-X is operated at X-band at **9.65 GHz**. Even pure visual interpretation will profit from the fact that the short wavelength shows more spatial detail than longer wavelengths.
- Furthermore, the satellite's **very high resolution** of up to 1 m and its **high radiometric accuracy**, make TerraSAR-X an ideal sensor to support sensitive decision-making in time-critical situations.
- The chirp bandwidth, an indicator of the spatial accuracy level, is with 300 MHz the best performance currently in space.
- Single, dual and quadruple **polarizations** allow for a more complex description of the areas and objects on the ground. Their availability depends on the imaging mode and always is a trade-off with the spatial coverage and swath width.
- **Radiometrically calibrated** data allow for an easy comparison between scenes.
- TerraSAR-X is both, **daylight and weather independent**, i.e. the system can record data at night and through clouds or dense smoke cover.
- The system features a **quick site access time** of 2.5 days to any point on Earth at 95% probability.
- TerraSAR-X features a **unique agility**: it is possible to switch between its three different imaging modes and various polarisations within only 1 to 3 seconds, corresponding to surface acquisition offsets of only 7 to 20 kilometres.
- Time-critical **data can be downloaded** within seconds after acquisition to mobile ground stations on-scene, thus enabling near-real time data processing.
- Anonymous and encrypted processes guarantee an unobjectionable **confidentiality**.
- **Satellite Tasking** twice a day and priority settings for the ordered data takes allow quick turnaround times in data delivery and late order changes.

## **Image Modes and Products**

In the standard operating mode image data in three different imaging modes can be acquired: SpotLight, StripMap and ScanSAR:

- **SpotLight** with up to 1 m resolution (10 km (width) x 5 km (length) image size) – the most sophisticated radar imagery available on the market: In flight direction, the radar beam

can be steered like a veritable spotlight, illuminating a particular ground scene for the longest time period possible, thus achieving an up to 1 metre class resolution as well.

- **StripMap** with up to 3 m resolution (30 km x 50 km standard scene size, extendable up to 1650 km acquisition length) – the ground swath is illuminated with continuous sequence of pulses while the antenna beam is fixed in elevation and azimuth. This results in an image strip with a continuous image quality (in flight direction). Besides dual polarization StripMap images will even be available as quadruple polarisation data, which allows for a more complete statistical description of the observed scene.

- **ScanSAR** with up to 16 m resolution (100 km x 150 km standard scene size, extendable up to 1650 km acquisition length) – Areas up to 165.000 km<sup>2</sup> anywhere on the globe can be covered in this image mode within only one orbit. In the ScanSAR mode, a swath width of 100 km (and even more) will be achieved by scanning four adjacent ground sub-swaths with quasi-simultaneous beams, each with different incidence angle.

From these imaging modes Basic Image Products are generated, giving the user the possibility to choose according to the specific needs – be it amplitude and phase information for interferometry or an already orthorectified dataset for rapid mapping.

The Basic Image Products are:

- Single Look Slant Range Complex (SSC) with amplitude and phase information in slant range geometry.

- Multilook Ground Range Detected (MGD) corrected to WGS84 with an average terrain height for slant range to ground range projection.

- Geocoded Ellipsoid Corrected (GEC) corrected to WGS84 with an average terrain height.

- Enhanced Ellipsoid Corrected (EEC) corrected to WGS84 with a digital elevation model (DEM).

In late 2009 TanDEM-X, a second satellite will be launched. The TanDEM-X mission aims at generating a global Digital Elevation Model (DEM) with an extremely high accuracy corresponding to HRTI-3 specifications defined by the U.S. National Geospatial-Intelligence Agency (z-accuracy better than 2 m).

This goal will be achieved by means of the second SAR satellite TanDEM-X flying in a combined orbit with TerraSAR-X. Thus SAR image and DEM data will synchronously be available for the same site.

Infoterra GmbH holds the exclusive commercial distribution rights for TerraSAR-X and the future TanDEM-X mission. In this turn Infoterra GmbH set up a global distribution partner network with more than 50 partners worldwide that is still increasing.