TerraSAR-X Mission Status

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Introduction

TerraSAR-X is Germany's first national remote sensing satellite being implemented in a public-private partnership between the German Aerospace Centre (DLR) and EADS Astrium GmbH, with a significant financial contribution from the industrial partner. This radar satellite, launched at June 15th 2007 will supply high-quality radar data for purposes of scientific observation of the Earth for a period of at least five years. At the same time it is designed to satisfy the steadily growing demand of the private sector for remote sensing data in the commercial market [1], [2], [3].

The TerraSAR-X features an advanced high-resolution X-Band Synthetic Aperture Radar based on the active phased array technology which allows the operation in Spotlight-, Stripmap- and ScanSAR Mode with various polarizations. It combines the ability to acquire high resolution images for detailed analysis as well as wide swath images for overview applications. In addition, experimental modes like the Dual Receive Antenna Mode allow for full-polarimetric imaging as well as along track interferometry, i.e. moving target identification.

The TerraSAR-X Satellite

The TerraSAR-X satellite bus is a heritage from the successful Champ and Grace missions. The TerraSAR-X features an advanced high-resolution X-Band Synthetic Aperture Radar based on the active phased array technology which allows the operation in Spotlight-,Stripmap- and ScanSAR Mode with two polarizations in various combinations.

TerraSAR-X at a glance:

Height:	4,88 m
Width:	2.4 m
Launch Mass:	1.230 kg (including payload mass 400 kg)
Radar Frequency:	9.65 GHz
Power Consumption:	800 W average
Resolution:	1 m, 3 m, 16 m
Launcher:	Dnepr 1 (ehemals SS-18)
Launch:	15 June 2007, 4:14 h (CEST) from Baikonur, Kazakhstan
Orbit:	514 km
Inclination:	97.4°, Sun-synchronous
Life time:	5 years

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The TerraSAR-X Ground Segment

The TerraSAR-X Ground Segment which is provided by DLR is the central element for controlling and operating the TerraSAR-X satellite, for calibrating its SAR instrument, and for archiving the SAR data as well as generating and distributing the basic data products.

The DLR Ground Segment is based on existing national infrastructure as much as possible and will be optimized for flexible response to (scientific and commercial) User requests and fast image product turn-around times. It is composed of three major elements:

- the Mission Operations Segment (MOS) provided by the German Space Operation Center (GSOC),
- the Instrument Operation and Calibration Segment (IOCS) provided by the Microwaves and Radar Institute (IHR), and
- the Payload Ground Segment (PGS) provided by the German Remote Sensing Data Center (DFD) and the DLR Remote Sensing Technology Institute (IMF).

Scientific Coordination and Commercial Exploitation

The scientific exploitation of the TerraSAR-X data will be coordinated by DLR, which is the point of contact for all science users.

Commercial customers, on the other hand, will have to contact Infoterra for access to TerraSAR-X data via the commercial TerraSAR-X Exploitation and Service Infrastructure (TSXX) developed by Infoterra. In addition to the baseline station in Neustrelitz, Infoterra will set up additional receiving stations for so-called Direct Access Customers (DACs) respectively Direct Access Partners (DAPs). These so called Direct Access Stations are foreseen to extend the baseline receiving station concept.

Mission Status - First TerraSAR-X Image

Only four days after launch the first SAR image was processed successfully [4]. As shown in figure 1, an 30 km x 60 km area in Russia, western to Wolgograd has been imaged in the stripmap mode, HH polarisation. The resolution is ca 15 m.

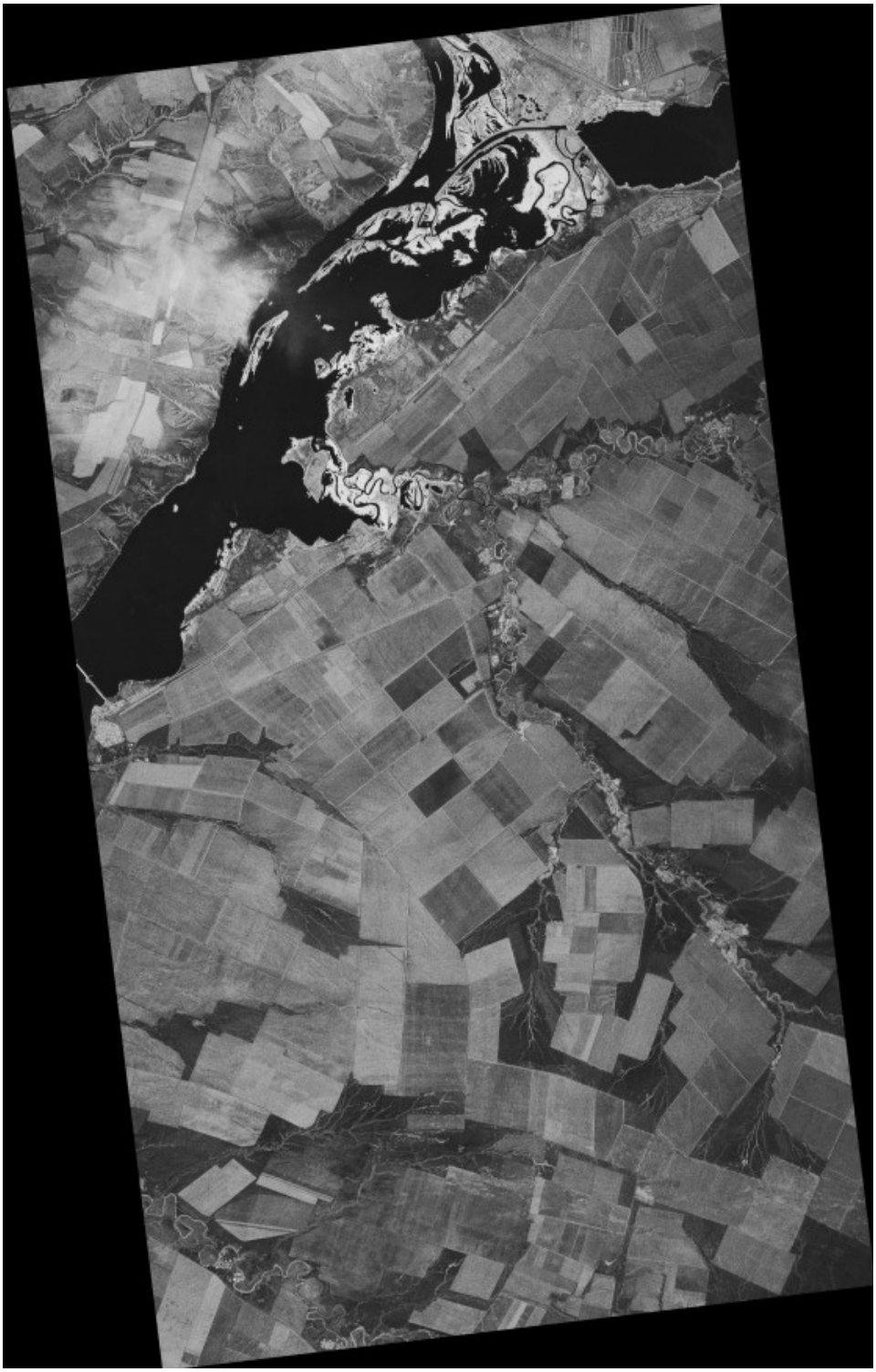

Figure 1: First TerraSAR-X image, Tsimlyanskoye reservoir, taken 19 June 2007, 15:03:24 UTC

In the upper half of the image, the Tsimlyanskoye reservoir can be seen. Here the River Don is dammed with the water being used for power generation. In the upper right corner of the view, you can

see a channel with a weir. In the immediate neighbourhood the meandering oxbow river bends can be seen as dark surfaces. Calm water surfaces are typically very dark in radar photographs, since the radar radiation hitting them is reflected away. In the centre-left of the image, a railway bridge over the River Don can be seen with the railway line disappearing towards the northeast.

In the lower half, large, agricultural areas dominate. The fields form regular patterns, on which can be spotted meandering tributaries. The different brightnesses result from the differing vegetation and the particular stages of their annual growth cycles.

During this survey, a thick cloud cover prevailed. Nevertheless, radar satellites such as TerraSAR-X offer imaging capability even in case of cloudy skies and at night. However, exceptional strong precipitation events like heavy thunderstorms may influence even radar imaging. Such an event can be seen at the upper left part of the radar image as a bright "veil".

The successful processing of the first image demonstrated the functional capability of the satellite on one hand and the operability of the ground segment on the other hand. The entire processing chain including order input, scheduling, commanding, data acquisition, on ground data reception, SAR processing and archiving of the images has been verified. This result was also the consequence of a comprehensive pre-launch testing programme including numerous space-to-ground-segment tests.

Meanwhile the commissioning phase is in progress involving tasks such as calibration, characterization/verification of the SAR-instrument, SAR system performance, orbit and attitude as well as product verification [5], [6], [7]. The aim is to ensure optimum SAR images and to accomplish the full operational readiness in December 2007.

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