German Aerospace Center

News Archive

The Earth in 3D - German radar satellite TanDEM-X launched successfully

21 June 2010

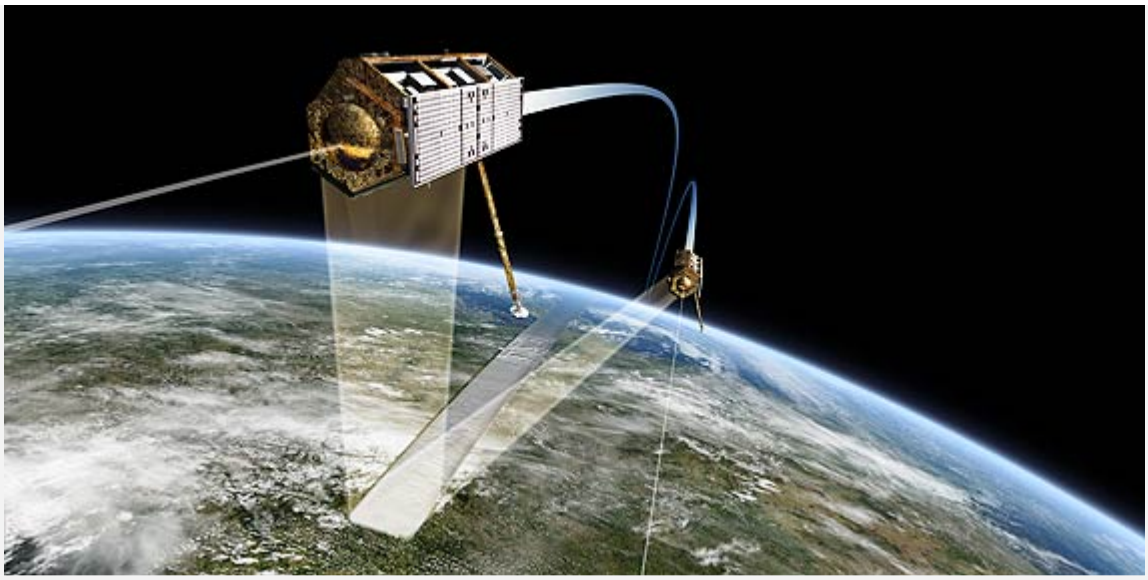
DLR responsible for mission operations and generation and utilisation of scientific data

Germany's second Earth observation satellite, TanDEM-X, was launched successfully on 21 June 2010 at 04:14 Central European Summer Time (CEST, at 08:14 local time) from the Baikonur Cosmodrome in Kazakhstan. Atop a Russian Dnepr rocket, the satellite, weighing more than 1.3 tons and five metres in length, started its journey into orbit. At 4.45 CEST first signal was received via Troll ground station in the Antarctic.

Launch of Germany's Earth observation satellite TanDEM-X

The German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) manages TanDEM-X (**T**erraSAR-X **a**dd-o**n** for **D**igital **E**levation **M**easurement) via its ground segment, and is responsible for mission operations and for generating and utilising the scientific data. "TanDEM-X is a key German project and will provide us with a homogeneous 3D elevation model of the Earth which will be an indispensable aid for a great many scientific and commercial avenues of enquiry," said DLR Chairman Prof. Dr Johann-Dietrich Wörner at the launch event held in the German Space Operations Center (GSOC) at the DLR site in Oberpfaffenhofen. "This mission demonstrates Germany's expertise in satellite-based radar technology and is, in particular, the outcome of a consistent focus in the national space programme. Also, TanDEM-X demonstrates a successful public-private partnership," stressed Prof. Wörner.

Public-private partnership



Flying in formation, TanDEM-X and TerraSAR-X

TanDEM-X is being run as a public-private partnership (PPP) between the DLR Astrium GmbH, with DLR funding coming from the German Ministry of Economics and Technology. Infoterra GmbH, a subsidiary of Astrium, is responsible for the commercial marketing of the TanDEM-X data. Astrium GmbH in Friedrichshafen built the satellite and is sharing the costs for its development and operation. The TanDEM-X mission has a total cost of 165 million Euros. DLR is contributing 125 million Euros and the European space company Astrium is contributing 40 million Euros.

TanDEM-X and its twin satellite, TerraSAR-X, will fly in formation

TerraSAR-X and TanDEM-X flying in close formation

Together with its twin satellite TerraSAR-X, in space since 2007, TanDEM-X will survey the entire land surface area of the Earth - a total of 150 million square kilometres - several times over. It will accomplish this from an altitude of 514 kilometres within three years. "This will be the first time we will ever have had a globally standardised 3D digital elevation model of Earth, and with a measuring point density of 12 metres, it will be incredibly accurate," said Prof. Dr Alberto Moreira, Science Director of the TanDEM-X mission and Director of the DLR Microwaves and Radar Institute.

Today, for large areas of Earth, there are only approximate, non-standardised or incomplete elevation models, and it is these gaps that the TanDEM-X mission is designed to fill. To accomplish this, TanDEM-

X and TerraSAR-X will fly just a few hundred metres apart and will constitute the first configurable synthetic aperture radar (SAR) interferometer in space.

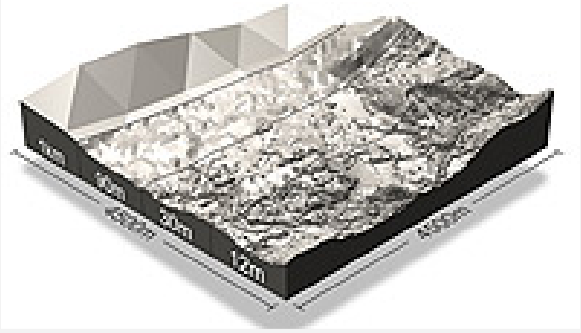
With a conventional SAR, the radar on the satellite transmits microwave pulses that are reflected by the surface of the Earth and received back by the radar. The distance between the satellite and the Earth's surface is calculated from the time it takes the signals to return. Since the satellite is moving around the Earth, the radar 'illuminates' a strip along the ground, which gives the radar its synthetic aperture, much larger than its real one.

With SAR interferometry, a geographical area is imaged from two different viewing positions, giving different perspectives. This is similar to the way humans use their two eyes to get an accurate, 3D image. The two 'radar eyes' are on the satellite duo TanDEM-X and TerraSAR-X, and produce an interferogram from the different distances the signals have to cover; elevation data is derived from this

Within three years, this will create a gigantic data record equivalent to the storage capacity of 200 000 DVDs. TanDEM-X is designed for a service life of at least five years and is scheduled to overlap the scheduled service life of TerraSAR-X for at least three of those years.

Satellite-based Earth measurement creates a globally homogeneous terrain model without interruptions at national borders or other inconsistencies (compared with aircraft-based measurements). Radar can see through bad weather and operates regardless of lighting conditions. Today, this process is without competitors and enjoys considerable respect, especially in the USA.

Tremendous variety of applications



TanDEM-X elevation model

Digital elevation models can be used in a huge range of applications. Geoscientific disciplines such as hydrology, geology and oceanography require precise and up-to-date information on the properties of the Earth's surface. Digital elevation models can help to make the exploitation of natural resources more efficient and can also help to optimise relief planning in the wake of natural disasters, as well as security deployments. Digital maps are also essential to reliable navigation: their precision needs to keep pace with the increasingly stringent requirements that govern global positioning.

Germany will be the first country in the world to have a digital elevation model of Earth, making it a globally unique data product. This can be used in initiatives and programmes such as the ZKI (Center for Satellite-Assisted Crisis Information at DLR), GMES (Global Monitoring for Environment and Security) and GEOSS (Global Earth Observation System of Systems), and may also be incorporated in security-related cooperation treaties and agreements.

Commercial customers around the world are looking forward eagerly to this TanDEM-X/ TerraSAR-X elevation model. As soon as it becomes available in 2014, remote observation and geoinformation experts from the private business sector, public sector authorities, defence and security facilities will benefit.

Data processing at the DLR in Oberpfaffenhofen – enhancement by Infoterra

Network of ground stations

A network of three TanDEM-X grounds stations (Kiruna in Sweden, Inuvik in Canada and O'Higgins in the Antarctic) is ready and waiting for the immense volume of raw data that the satellites will generate. This data will be processed in three main steps: initially, the data transmitted by TanDEM-X to these ground stations will be examined. Then the results will be evaluated at the DLR's German Remote Exploration Data Center (DFD) in Oberpfaffenhofen and processed into raw versions of elevation models. The global digital elevation model is then generated by a unit known as the mosaicking and calibration processor. The data records for the global elevation model will amount to 15 terabytes and will be available about four years after the launch of TanDEM-X.

Adaptation of the elevation model to the needs of commercial users and its worldwide marketing will be handled exclusively by Infoterra GmbH. As part of the data enhancement process, Infoterra will further process the raw data supplied by the satellite system to meet the requirements of its various customers. It is standard practice to edit out anomalies known as 'spikes' (abnormal peak readings caused by interference), offsets (which radar shadows can produce, especially in mountainous terrain) and areas of surface water (assurance of standard water levels and the correct angle of downhill gradient for rivers).

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