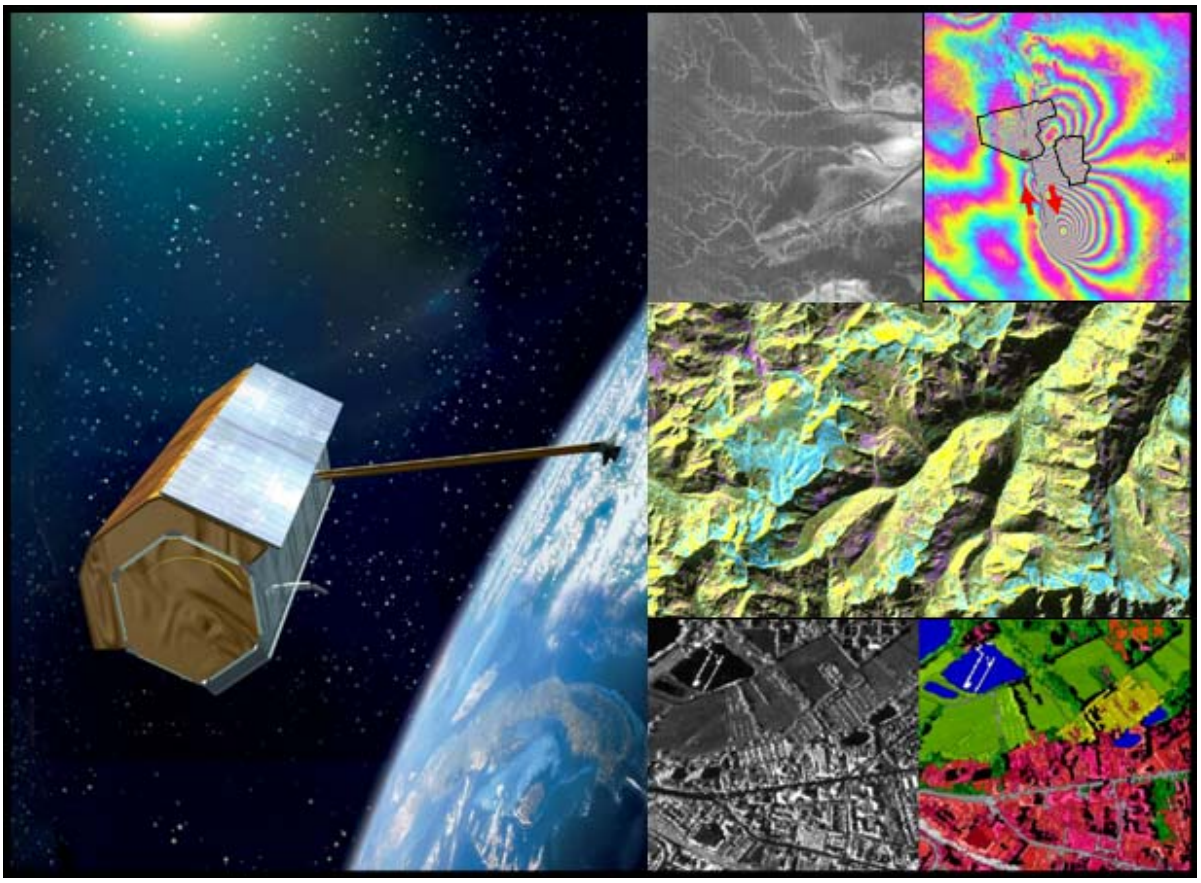
Doc.: TX-PGS-PL-4142
Issue: 1.0
Date: 05.04.2016

TerraSAR-X

Announcement of Opportunity: Special Products



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1 INTRODUCTION

1.1 PURPOSE AND STRUCTURE OF THE DOCUMENT

This document describes the Call and procedure to conduct scientific research and education, as well as to develop, evaluate and demonstrate new applications using special products of the TerraSAR-X and TanDEM-X missions.

Chapter 2 describes the objectives of the Announcement of Opportunity related to the utilization of experimental TerraSAR-X data and TerraSAR-X like processed data acquired by the TanDEM-X mission. Chapter 4 provides information on the AO procedure, including submission guidelines, proposal evaluation, how the proposal shall be implemented as a project, data costs and schedule. The data rights are provided as Annex in the user license agreement.

This document describes the specific conditions and procedures applicable to proposals related to the Special Products Announcement of Opportunity (AO).

1.2 APPLICABLE DOCUMENTS

[A1] TerraSAR-X Science Plan, TX-PGS-PL-4001, Issue 1.0, 25.11.2004

[A2] Gesetz zum Schutz vor Gefährdungen der Sicherheit der Bundesrepublik Deutschland durch das Verbreiten von hochwertigen Erdfernerkundungsdaten (Satellitendatensicherheitsgesetz, SatDSiG); 23.11.2007

1.3 REFERENCE DOCUMENTS

[R1] TX-GS-DD-3302 – Basic Product Specification Document, Issue 1.7, 15.10.2010

[R2] TX-GS-DD-3303 – Experimental Product Description, Issue 1.3, 6.10.2006

[R3] TX-PGS-PL-4403 - User License for the Utilization of TerraSAR-X / TanDEM-X Data and Products for Scientific Use, Issue 2.0, 31.1.2011

[R4] TX-PGS-PL-4111 – Announcement of Opportunity: Experimental Products of the Dual Receive Antenna Campaign 2010, Issue 1.0, 01.06.2010

[R5] TD-GS-TN-3039 – TerraSAR-X Like Products from the TanDEM-X Pursuit Monostatic Phase, Issue 1.0, 22.01.2016

[R6] TD-PD-PL-0032 – Announcement of Opportunity: TanDEM-X Science Phase, Issue 1.0, 19.5.2014

2 MISSION OVERVIEW

TerraSAR-X is an operational, advanced SAR-satellite system for scientific and commercial applications that was launched on June 15th, 2007. The expected lifetime is 5 years. It carries a high frequency X-band Synthetic Aperture Radar (SAR) sensor that can be operated in different modes and polarisations. The Spotlight-, StripMap- and ScanSAR-modes provide high resolution SAR images for detailed analysis as well as wide swath data whenever a larger coverage is required. Imaging is possible in single, dual and quad-polarisation, the latter by employing a redundant receiver.

Earth observation is a well suited tool to monitor a world that is changing. The corresponding geo-information products support the investigation and understanding of the processes causing and resulting from the change. They also help to explore, manage and preserve the Earth's resources. TerraSAR-X data help to extend the range of parameters observed and therewith to increase the knowledge of the factors determining the behavior of the environment. Furthermore the data can be used to support the monitoring and management of the Earth's resources.

The objective of all calls for proposals is to foster the scientific use of TerraSAR-X data. Common to all calls is the provision of products according to the **"TerraSAR-X Basic Products" as described in [R1]**. This includes single and dual polarised data in StripMap and Spotlight modes provided as single look complex but also detected images in ground range or a map projection. ScanSAR data are available as detected as well as complex images. All these products support mapping and monitoring as well as applying SAR interferometry (InSAR) to observe and measure ground movements. The high resolution and short revisit times of TerraSAR-X provide new perspectives for these purposes. In order to support interferometric applications repeat orbits are maintained such that they are within a ± 250m tube relative to the reference orbit.

The current call in addition addresses archived **"TerraSAR-X Experimental Products" [R2]** as well. In the so called dual receive antenna mode the antenna is electrically split into a fore and an aft segment during receive. This configuration is operated in StripMap mode only and provides either full (quad-) polarized data or distinct images from the two separate positions in space of the antenna halves. The latter enables to perform along track interferometry.

3 DESCRIPTION OF THE CALL

Main purpose of the current call is the provision of products acquired by the **TanDEM-X** mission in **pursuit monostatic mode** that were processed to TerraSAR-X like products. The corresponding images were acquired in single/dual and quad polarisation, the latter in Dual Receive Antenna Mode.

3.1 TERRASAR-X LIKE PRODUCTS FROM TANDEM-X PURSUIT MONOSTATIC MODE

The TerraSAR-X and TanDEM-X missions are operated in parallel by using the same satellites. Therefore conflicts occur between different user requests that can cause the loss of acquisitions. In order to compensate this loss to some degree data acquired in **pursuit monostatic mode** during the **TanDEM-X science phase** were separately processed to so-called "TerraSAR-X like products". The corresponding images were acquired in single and dual polarisation. These products comprise just one data set of the TanDEM-X image pairs. Users that wish to get co-registered SLC pairs, or further TanDEM-X products need to submit a corresponding proposal to the TanDEM-X Science Coordination (https://tandemx-science.dlr.de/) .

Different modes were operated during the TanDEM-X Science Phase. The **interferometric mode** comprises **Pursuit Monostatic**, Bistatic and Alternating Bistatic Mode. The mission timeline of the TanDEM-X Science Phase was split into the **Pursuit Monostatic (between October 2014 and March 2015)** and the Bistatic Phase (between March 2015 and end of 2015).

More details and information is provided in [R5] and the Announcement of Opportunity for the TanDEM-X Science Phase [R6] that can be downloaded at https://tandemx-science.dlr.de/.

3.2 DUAL RECEIVE ANTENNA MODE CAMPAIGNS

TerraSAR-X and TanDEM-X can be operated in the so-called Dual Receive Antenna Mode that enables the acquisition of full polarimetric data or alternatively the operation with four phase centres, e.g for tracking fast moving targets. The DRA mode was activated for two campaigns, one in 2010 and the second time for the TanDEM-X Science Phase.

3.2.1 DRA CAMPAIGN 2010

StripMap mode data were acquired in the DRA mode in a dedicated 33 days lasting campaign in **April and May 2010**. Either quad-polarization or single polarized along track mode were operated. Predefined test sites were observed, most of them at least twice. The test sites were selected in order to support a variety of applications.

3.2.2 DRA FROM PURSUIT MONOSTATIC PHASE (2014/2015)

StripMap mode data were acquired in the DRA mode during the Pursuit Monostatic Phase between **October 2014 and March 2015**, too. These data of the TanDEM-X Science Phase were separately processed to so-called "TerraSAR-X like products" as well and comprise just one data set of the TanDEM-X image pairs.

3.3 EXPERIMENTAL PRODUCTS

In the dual receive antenna mode the antenna is electrically split into a fore and an aft segment during receive. This configuration is operated in StripMap mode only and provides either full (quad-) polarized data or distinct images from the two separate positions in space of the antenna halves. The latter enables to perform along track interferometry.

Quad-polarisation products: Like in dual polarisation mode horizontal and vertical polarisation are transmitted in a pulse to pulse alternating mode. During receive different polarisations are selected in both antenna segments. The result is a StripMap product covering the swath width of a dual polarised image (15 km).

Along Track Interferometric (ATI) products: Here the same polarisation is kept when operating the fore and aft antenna segments. Due to the baseline in flight direction between the separated antenna phase centres, this ATI mode allows to exploit the interferometric phases of the two channels for applications like moving target detection or ocean current studies. Experimental ATI products are acquired in Stripmap single polarization mode only

3.4 GENERAL SCIENTIFIC OBJECTIVES OF TERRASAR-X

Earth observation is a well suited tool to monitor a world that is changing. The corresponding geo-information products support the investigation and understanding of the processes causing and resulting from the change. Based on these findings reliable services can be provided to support environmental and climate protection, regional planning, development aid and security-related issues.

In particular the use of TS-X data shall help to extend the range of parameters observed and therewith to increase the knowledge of the factors determining the behavior of the environment. Furthermore the system shall support the management and monitoring of the Earth's resources and to better understand the solid Earth processes.

New and innovative technological features of the SAR instrument enable the improvement of existing and the development of new technologies and applications. Both application and technological development shall aim at a further improvement of the Earth observation services.

Generally proposals shall address at least one of the following objectives:

- Scientific evaluation of TerraSAR-X data
- Stimulating the development of a commercial EO-market
- Support of the mission calibration and validation activities.

3.5 ANNOUNCEMENT OBJECTIVES

3.5.1 SCIENCE AND RESEARCH

The main objective is to support scientific projects addressing global change issues. For this purpose special TerraSAR-X data shall be made available from the TerraSAR-X archive to support the investigation of temporal changes of the sea as well as land surfaces, coastal waters and Polar Regions. It is expected that the proposals will address at least one out of the following application themes:

- Land Cover & Vegetation
- Water Resources & Hydrology
- Ocean & Marine Application
- Polar Research
- Risk Management & Security
- SAR Methods & Research

3.5.2 CALIBRATION AND VALIDATION

Proposals can address calibration and validation issues like the investigation of instrument long term stability and the product quality.

3.5.3 STIMULATION OF COMMERCIAL USE

The stimulation of the commercial EO-market might address

- the development of improved image processing and information retrieval techniques,
- the development and definition of new applications, geo-information products and services.

Accepted proposals will get TerraSAR-X data for the purpose of the described research.

3.5.4 GENERAL CONSTRAINTS

The call is **open to international participants**. The **access is limited to archived data**. Accepted proposals will get a limited number of products **free of charge** that will be delivered electronically (see also chapter 4.7).

The **duration of the call is unlimited**.

The time span for the proposal's execution **should not exceed two years after the date of the proposal's acceptance**.

4 AO PROCEDURE

TerraSAR-X data will be provided to projects targeting scientific use within the mission objectives. The status "Scientific Use" needs to be gained via a selection process. For this purpose current Announcement of Opportunity (AO) is released. Proposals need to be submitted via a web interface. Each submitted proposal will then go through a scientific and technical evaluation. One proposal should be related to one project. Principal Investigators (PI) may submit several proposals.

Investigators may form consortiums that will utilise the TerraSAR-X data jointly. For each proposal one PI has to be identified who will act as an interface to the TerraSAR-X project.

The PI will be informed about the evaluation results. The use of TerraSAR-X data is regulated via a license agreement [R2], which must be signed by the PI and all Co-Is. The corresponding account will be released when all required information and documents are on hand at DLR. It will enable downloading data from the DLR archive. New acquisitions are not supported.

4.1 SUBMISSION GUIDELINES

The proposal must be submitted electronically. The URL **http://sss.terrasar-x.dlr.de/** will guide to the corresponding proposal submission interface. Mailed proposals will not be accepted.

The proposal should clearly describe the intended research, the scientific benefit, the contribution to the mission objectives and the required data. In particular the following information should be provided:

- General information about the PI and the person authorised to sign the license agreement;
- the list of all Co-Is and the team organization;
- the innovation of the proposed activity and the contribution to the mission objectives;
- a detailed description of the intended work;
- the work plan and schedule;
- the data requirements; and
- information demonstrating the coverage of the "scientific use" criteria (see chapter 4.2 and [A1]).

The title, the PI and the executive summary of accepted proposals will be made available to the public on a dedicated web page.

The web page supports proposal submission in several steps. It can be modified until the submission confirmation button is pressed. This step releases the proposal for the evaluation process and marks the formal submission of the proposal. The investigators are kindly asked to consider deadlines (see chapter 3.5.4 and dates published at **http://sss.terrasar-x.dlr.de/**). The acceptance of delayed proposals can-

not be guaranteed.

New investigators must register first. Registered investigators can directly create a new proposal.

The AO ID that the proposal shall be assigned to is

TSX-Special-Products

It is assumed that every person listed as Co-I or in the list of authorized people will get access to the experimental TerraSAR-X products and that the list is complete. The PI is responsible for keeping both lists up to date during the lifetime of the project. An editing will be possible at any time.

4.2 DEFINITION OF SCIENTIFIC USE

Scientific, non-commercial use of TanDEM-X / TerraSAR-X data is defined as follows:

Every use of TanDEM-X / TerraSAR-X data and basic products for basic and application oriented research by national or international research institutions or through the german government sponsored projects is considered scientific, non-commercial use, including the development of future applications for scientific and/or operational use.

Every utilisation of TanDEM-X / TerraSAR-X data/products that is not targeting the commercial use with profit orientation is a scientific use.

This includes the use of TanDEM-X / TerraSAR-X data/products:

- by educational (schools, universities, etc.) and research institutions (DLR, ESA, NASA, etc.)
- for preparation and execution of government financed education-, research- and development-programmes
- for preparation and execution of data exchange with international partners of the FRG to support research- and educational programmes
- for demonstration of new applications for potential users
- for use within the TanDEM-X / TerraSAR-X project (calibration, validation, quality assurance, public outreach, experimental instrument operations, etc.)

Scientific Users:

- will be generally provided with data/products via a selection process (e.g. an Announcement of Opportunity (AO) for the Scientific Exploitation of TanDEM-X / TerraSAR-X data).
- are required to follow the license agreement for use of TanDEM-X / TerraSAR-X data

must not hand over the TanDEM-X / TerraSAR-X data/products or derived products (to the extent that the contribution of TanDEM-X / TerraSARX is substantial and recognisable) to third parties without au-

thorisation by DLR

4.3 EVALUATION

Each proposal will go through a scientific and technical evaluation. This will be the task of an international team of evaluators consisting of DLR internal and external SAR experts. The reviewers will judge the scientific benefit and the data requirements while DLR will check additionally whether the scientific use criteria are met.

As a result of the evaluation process a user account will be created for each accepted proposal and the announced quota will be assigned.

The investigator shall be informed about the evaluation within 2 months after submission.

4.4 SECURITY REGULATIONS

The provision of TerraSAR-X data is governed by national security regulations. These regulations might affect the location of the test site, the acquisition time and the persons involved. DLR will be obliged to verify the sensitivity of data requests. The sensitivity check will be performed in two steps:

- The proposal evaluation includes the verification of the investigators and the team members.
- The main sensitivity check will be applied to each order and will comprise location, time and the persons involved.

In case of sensitivity of an order DLR needs to apply for authorisation of distribution by a state authority to be determined. This means that orders still can be rejected even for accepted proposals.

Please note that further regulations might be required after the release of the regulation law [A2].

4.5 PROJECT IMPLEMENTATION

Summarizing the procedure described so far AO projects are implemented in the following steps:

- Proposal submission (investigator);
- proposal evaluation (DLR);
- proposal acceptance (DLR);
- signature and provision of the license agreements (investigator);
- provision of user account details and release for ordering (DLR);
- execution of proposed work (investigator);

- provision of reports (investigator);
- participation in Science Team Meetings (investigator);
- provision of final report (investigator);
- removal of all TerraSAR-X data (investigator); and
- closing of user account for ordering (DLR).

4.6 ROLE OF THE PRINCIPLE INVESTIGATOR

The Principle Investigator (PI) shall act as an interface between the consortium and DLR. The PI will be responsible for

- ensuring the consideration of the security regulations,
- ensuring the validity of the "Scientific Use" criteria for all investigators (including the Co-Is),
- reporting of any changes that might effect the national security regulations or the status "Scientific Use" to DLR,
- distributing the TerraSAR-X data within the project
- publishing of the results in publications of international renown
- reporting to DLR; and
- documenting the progress and results concluding with the submission of a final report to DLR.

The PI's activities are considered to cover the total time period of the project approved by DLR.

4.7 COST OF THE DATA

Electronically delivered data will be provided free of charge. The delivery on a physical medium like DVD is not foreseen.

5 REPORTING AND PUBLICATION

The data policy issues as described in [A1] will be applied. A major goal of this AO is to stimulate the scientific utilization of TerraSAR-X data. Therefore it is expected that the investigators will make their results available to the public. This is mostly done by publications. The TerraSAR-X project will provide two platforms for this purpose:

- The project web site will provide a dedicated page where the reports are published. This page optionally can also be supplemented with further downloadable pdf-documents like other publications.
- The second platform is the Science Team Meeting. The information exchange and the transfer of procedures and techniques into operational and commercial utilization shall be supported by these meetings. Proceedings of these meetings will be compiled and published.

The progress of the project shall be reported. The reports furthermore demonstrate the utilization of the TerraSAR-X data. As mentioned earlier it is a vital interest of the project that the TerraSAR-X data are used. Therefore DLR reserves the right to terminate the provision of data whenever the corresponding utilization is not demonstrated.

Further regulations are provided in the User License Agreement (see http://sss.terrasar-x.dlr.de/ => documentation).

6 POINTS OF CONTACT

Questions related the proposal submission, evaluation, scientific use etc. should be addressed to the TerraSAR-X Science Coordinator:

Achim Roth

Tel: 08153 / 28-2706

Fax: 08153 / 28-1458

Email: tsx.science@dlr.de

Questions related to ordering and order status as well as the provision of product descriptions etc. should be sent to the Orderdesk of DLR-DFD:

Tel: 08153 / 28-3217

Fax: 08153 / 28-3444

Email: DFD-Orderdesk@dlr.de