

# TerraSAR-X Applications Guide

**Extract: Change Detection and Monitoring:  
Forestry**

April 2015

## Change Detection and Monitoring: Forestry

### Issue

Anthropogenic pressures exerted on forests are growing and need to be monitored. Sustainable management of forest ecosystems is strongly encouraged and funded, for example through new monetisation mechanisms like REDD+. Satellite imagery supports to monitor forests and above all providing vital decision-support tools for forest managers.

Optical satellite imagery very often fails for forest monitoring in clouded regions due to lack of suitable time series of cloud-free imagery in general and delays in acquisition of cloud-free imagery.

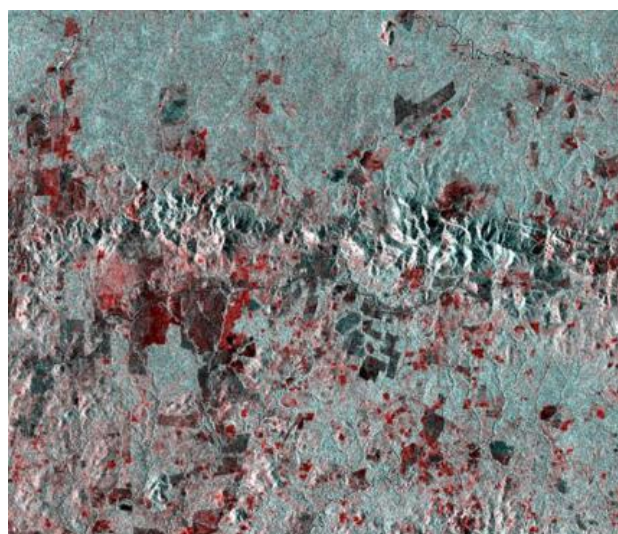


### Markets

Civil Institutions, Civil Commercial

### Achievements

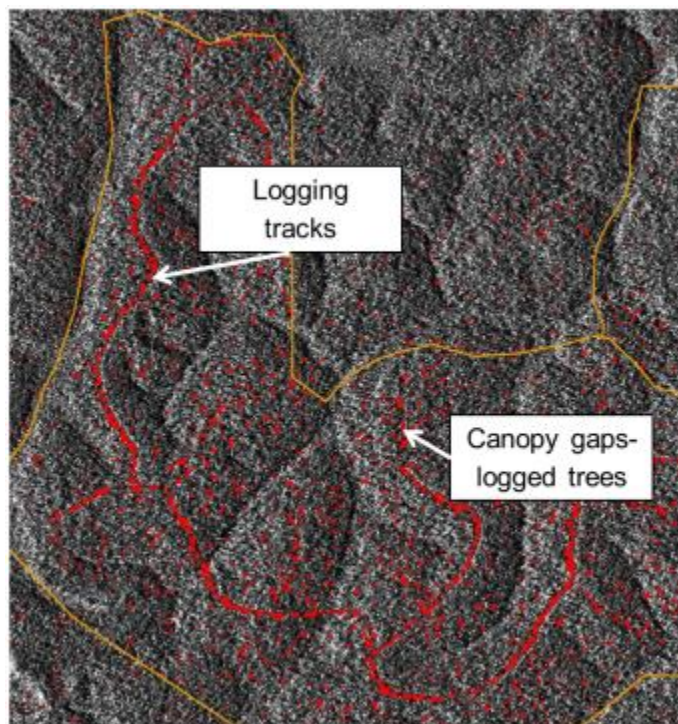
TerraSAR-X can be utilised for forestry related change detection by applying Amplitude Change Detection approaches based on repeat pass imagery of the sensor. The imagery is statistically analysed and change layers are automatically extracted. For interactive interpretation or evaluation, the detected changes, e.g. induced by new clear-cuts can also be visualised by generating colour composites of TerraSAR-X imagery acquired in between the monitoring period (Figure 1).



*Figure 1: TerraSAR-X Sample for Amplitude Change Detection applied for forestry in Nicaragua between 07/02/2005 and 16/05/2008 – changes related to clear-cuts are indicated in red*

By applying a distinct change detection processing chain, a change indicator layer can be calculated e.g. for guiding terrestrial ground truth / validation work.

The product can also serve as an input for further assessment of forest disturbances e.g. through forest consultants. This assessment requires further forestry expert knowledge and yields valuable information for either forest management or REDD+.



*Figure 2: Change indicator layer produced from TerraSAR-X StripMap (3m) for Pallisco concession Cameroon; changes are indicated in red.*

## Benefits of using TerraSAR-X

TerraSAR-X offers weather and day-light independent site access to any point on earth. This results in more consistent coverages with regards to input data quality, time consistency and actuality.

Furthermore, TerraSAR-X provides excellent radiometric stability over time, which results in comparable backscatter in repeat-pass acquisitions enabling fully automatic processing chains for forestry related change detection.

The geometric accuracy of TerraSAR-X is unrivalled by any other commercial space-borne sensor today and allows accurate localisation of forest changes. It also allows sub-pixel co-registration of repeat pass imagery for change detection. This is particularly relevant when field measurements of small extent are combined with remote sensing data.

The flexible resolution and coverage of TerraSAR-X enables a choice of most appropriate spatial resolution and coverage.

Furthermore, the high acquisition frequency provides a good temporal sampling for change detection. With the availability of TerraSAR-X / PAZ constellation a daily revisit will be available for most latitudes.

## Relevant Data Specifications

Table 1: Recommended Image Specification

<b>Image Modes:</b>	StripMap, SpotLight, High Resolution SpotLight, Staring SpotLight	
<b>Number of datasets:</b>	Two (acquired with exactly the same acquisition parameters, i.e. repeat pass)	
<b>Assumed Analysis Approach:</b>	<ul style="list-style-type: none"> <li>Amplitude Change Detection utilizing colour composite for two acquisitions,</li> <li>Coherence Change Detection utilizing a calculation of coherence between acquisitions.</li> </ul>	
<b>System Settings:</b>	<b>Polarization:</b>	VV or HH
	<b>Incidence Angle [Degree]:</b>	> 30°
	<b>Orbit</b>	Ascending or Descending
<b>TerraSAR- Image Product</b>	<b>Basic Image Product:</b>	MGD, EEC, GEC (if ACD is applied), SSC (if CCD is applied)
	<b>Resolution Mode:</b>	<ul style="list-style-type: none"> <li>SSC: N.A</li> <li>MGD, EEC, GEC: Radiometrically Enhanced (RE)</li> </ul>
	<b>File Format:</b>	COSAR

Note: Recommended image specification is an indication only. It may vary depending on the software used. Airbus Defence and Space, Geo-Intelligence does not guarantee relevant capability.

## Relevant Products and Services available from Airbus Defence and Space, Geo-Intelligence

### Change Indicator Product

### Available Case Studies

- “TerraSAR-X based Monitoring of Forest Degradation in Ghana”

### Related Publications

- Information available on Request

### Related Sample Datasets

- 3 x StripMap Porto Velho, Brazil (MGD, RE, HH)
- 3 x StripMap Harpan Forest Sumatra, Indonesia (SSC, VV)



## Suitable Software

Application	Company Name								
	BAE Systems	Exelis	GAMMA Remote Sensing AG	Hexagon Geospatial/ GEOSYSTEMS GmbH	Joanneum Research	PCI Geomatics	Racurs	Textron Geospatial Solutions	Trimble
	Provided Software								
	SOCET GXP	ENVI SARscape	GAMMA MSP,ISP,DIFF&GE O,LAT,IPTA	ERDAS IMAGINE	RSG - Remote Sensing Software Package Graz	Geomatca and GXL	Photomod Radar	RemoteView, ELT5500, and Global ImageViewer	eCognition
<b>Change Detection</b>									
• Interferometric Coherence Change Detection		X	X	X	X	X	X		
• Amplitude Change Detection		X	X	X	X	X	X	X	X

*Note: Information provided by Software Providers, Airbus Defence and Space, Geo-Intelligence does not guarantee relevant capability.*

## Contact

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For feedback or further inquiry please contact the Airbus Defence and Space Customer Service Centre via telephone at +49 7545 8 4344 / eMail: [terrasar@astrium-geo.com](mailto:terrasar@astrium-geo.com) or visit <http://www.geo-airbusds.com/terrasar-x/>

## List of Abbreviations

<b>ACD</b>	Amplitude Change Detection
<b>CCD</b>	Coherence Change Detection
<b>DEM</b>	Digital Elevation Model
<b>DInSAR</b>	Differential Interferometry
<b>DSM</b>	Digital Surface Model
<b>DTM</b>	Digital Terrain Model
<b>EEC</b>	Enhanced Ellipsoid Corrected (Basic Image Product)
<b>EGR</b>	Enhanced Gas Recovery
<b>EMSA</b>	European Maritime Safety Agency
<b>EOR</b>	Enhanced Oil Recovery
<b>EU</b>	European Union
<b>EEZ</b>	Exclusive Economic Zone
<b>GCP</b>	Ground Control Points
<b>GEC</b>	Geocoded Ellipsoid Corrected (Basic Image Product)
<b>GEO</b>	Airbus Defence & Space, Geo-Intelligence
<b>HS</b>	High Resolution SpotLight (imaging mode)
<b>IMINT</b>	Image Intelligence
<b>InSAR</b>	Interferometric SAR
<b>IWS</b>	Interferometric Wide Swath (Sentinel-1 imaging mode)
<b>MGD</b>	Multi Look Ground Range Detected (Basic Image Product)
<b>NRT</b>	Near-Real-Time
<b>PSI</b>	Persistent Scatterer Interferometry (PSI)
<b>RE</b>	Radiometrically Enhanced
<b>REED+</b>	Reducing Emissions from Deforestation and Forest Degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries
<b>SAR</b>	Synthetic Aperture Radar
<b>SBAS</b>	Small Baseline Subset Interferometry
<b>SC</b>	ScanSAR (imaging mode, 4-beam ScanSAR)
<b>SE</b>	Spatially Enhanced
<b>SL</b>	SpotLight (imaging mode)
<b>SM</b>	StripMap (imaging mode)
<b>SSC</b>	Single Look Slant Range Complex (Basic Image Product)

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<b>SRTM</b>	Shuttle Radar Topography Mission
<b>ST</b>	Staring SpotLight (imaging mode)
<b>WS</b>	Wide ScanSAR (imaging mode, 6-beam Scan SAR)