

# TerraSAR-X support to DeforestAction in Borneo

Success Story on the use of EO to provide the intelligence required to halt illegal deforestation.

## Summary

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Students monitored rainforests using Earthwatchers (geospatial crowd-sourced web-monitoring tool) and Earth Observation to provide the intelligence required to halt illegal deforestation. In the presented pilot of Earthwatchers concept near real-time access to EO data was secured through TerraSAR-X ortho-rectified imagery and automatically generated change information. The overall service provides a new approach to education by involving users directly in the conservation effort with direct access to real data. Knowledge and results are shared by collaborating in a social media environment.

## Project Background

[blocked URL](#) The second largest island in the world, a mere half century ago, Borneo was covered nearly entirely by tropical rainforest. Illegal logging activities and the conversion of land for palm oil plantations has however drastically reduced rainforest acreage, to the detriment of orangutan populations. This has also contributed substantially to the accumulation of greenhouse gases. According to the WWF, 75% of the wood in Indonesia is obtained from illegal logging. The scope of the problem is acknowledged both in the scientific world and in politics, as is the necessity to preserve the rainforest. However, new solutions are urgently needed as large areas of rainforest are disappearing on a daily basis.

## Issues & Needs

DeforestACTION is a worldwide action plan to save the rainforest, and is a campaign in which young people from all over the world are involved. It aims to help monitor deforestation in Borneo in order to preserve and protect the habitat of the orangutan and preserve livelihoods of local communities.

The difficulty fighting illegal logging in Indonesia is to locate and identify the deforestation in vast and inaccessible areas early enough to initiate mitigation action.

## Solution

A new software tool 'Earthwatchers' developed by GEODAN for the DeforestACTION project and a large range of Earth observation data are used to tackle the problem. This allows young people all over the world to monitor the rainforest with the aid of a webGIS environment and current satellite images and publish reports on their findings.

However to effectively combat illegal logging timely provision of up-to date EO imagery covering large regions at high resolution to detect skid trails and also small scale changes of forest canopy is required. Frequent acquisitions of optical imagery are hindered by almost permanent cloud cover over Borneo.

The radar satellites TerraSAR-X and TanDEM-X are able to reliably provide high-resolution SAR imagery with a resolution of up to 1m independent of weather conditions and illumination. In addition they exhibit a unique geo-localization accuracy which is a prerequisite for field teams (eco-warriors) to find distributed small scale loggings. These facts make the imagery particularly well suited to monitor Borneo's rainforests. Therefore TerraSAR-X imagery and derived change indicators were gathered to the DeforestAction project by Astrium GEO-Information Services and have been used in the EarthWatchers test campaign in 2012.

## Results & Perspectives

EarthWatchers application provides access to current EO data and enables participants from around the world to monitor the forests of Borneo and provide usable intelligence to help stop deforestation.

Astrium Geo-information Services made available TerraSAR-X and TanDEM-X radar imagery and derived change products in a few hours after acquisition for a site near Ensaid Panjang despite the challenge of conflicts with commercial orders and TanDEM-X mission objectives<sup>1</sup>. Imagery for two test sites in West Kalimantan has been acquired. TerraSAR-X high resolution SpotLight of Ensaid Panjang was used to directly compare with the Landsat images reflecting the status of forest in 2008 and 2010. For the second test site Tembak extending approximately 100 km by 60 km TerraSAR-X StripMap imagery was acquired in 3 m resolution mode to achieve larger coverage. The acquisition was repeated under the same geometry one month later allowing for direct comparison of measured radar backscatter values. This form of image comparison is the basic concept for Astrium GEO's SAR based change detection product and services. It is very sensitive to surface changes and proved that even small scale selective logging activities can be detected which indicate forest degradation. An example of a change detected with TerraSAR-X in a vast forest area has been used for the EarthWatchers videos.

- <http://video.esri.com/watch/1651/earthwatchers>
- <http://www.ecowarriorsrise.com/>
- <http://vimeo.com/64511800>

In the EarthWatchers application the rainforest to be monitored is divided up into 1.6 km<sup>2</sup> hexagons, and these are assigned to individual 'agents'. These agents monitor their parcels and through the use of satellite imagery, identify and mark changes in land patterns over a period of time, and are able to work together in a social-network environment.

On ground EarthWatchers are supported by Eco Warriors who also assisted the villagers of Ensaid Panjang longhouse who are facing challenges to hold on to their community forest against palm oil companies. Verified changes are shared with relevant local authorities, who will then investigate any deforestation in that area.

The project demonstrates new ways to preserve forests at risk and create livelihoods for local landowners as well as helping animals who are victims of deforestation. It creates a global awareness campaign for the destruction caused by palm oil production.

*'Many people are worried about the condition of the rainforest here and would like to make a contribution to finding a solution. With this project, we make it possible for everyone to take action themselves. This way, people are part of the solution and, using the Earthwatchers application, they are able to see for themselves what is happening'.*

The benefits of the combination of web-GIS based innovative software and radar based Earth Observation such as TerraSAR-X /TanDEM-X are manifold. Overall, it involves Earthwatchers from around the world in forest conservation efforts via Satellite Earth Observation (crowd-sourcing effort allocating small areas to millions of volunteers each) and increases environmental and specific deforestation awareness.

High resolution weather independent radar data like TerraSAR-X and Tandem-X is indispensable for tropical rainforest monitoring. However, fully automated change products show all surface changes and have to be evaluated by human intelligence. The developed crowdsourcing tools and techniques for human computation of radar earth observation deployed on a webGIS environment linked to social media enable collaborative intelligence (joint decision by crowd wisdom) and improving the system by self-learning on results. It proves that useful results can be harnessed from radar earth observation analyzed using human computation (in a crowdsourcing effort).

The program contributes by teaching the interpretation of radar imagery which is not as intuitive as optical imagery and creates awareness and learning materials about earth observation (especially radar) tailored to students aged 12-18. In addition the Earthwatcher tool makes available and accessible different geographic layers of the specified area for the Earthwatchers to explore and understand the inter-relationship between biotic and abiotic factors in forest conservations (biodiversity layer, forest density, human accessibility and infrastructure, carbon deposits, etc).

The Earthwatchers application gives schoolchildren a fun way to learn about advanced technology such as social media, GIS and remote sensing. By adding special context information, such as rivers and palm plantations, the application is also suitable for use in teaching programs addressing deforestation issues.

[www.deforestation.org](http://www.deforestation.org)

(1) The aim of the TanDEM-X mission is to acquire the data basis for the [global Digital Elevation Model \(DEM\)](#), [WorldDEM™](#).

## Related Info

- Service provider: Geodan, Astrium GEO-Information Services
- User/Customer: EarthWatchers, Eco Warriors, local communities & land owners, Environmental conservation NGOs, Institutions responsible for REDD+ MRV implementation
- EOservice: Detect illegal forest activities. Timely support of web-based crowd-sourced rainforest monitoring by TerraSAR-X imagery & automatic change detection layers
- Keywords: 2012, Kalimantan, Indonesia / Forestry / Detect illegal forest activities, Earthwatchers, TerraSAR-X, TanDEM-X, deforestation, forest degradation, forest monitoring, illegal logging, change detection, crowd-sourcing, webGIS