Newsletter

Issue 14
28 November 2013

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 262786 EUFODOS

Preamble from the coordinator

By Mathias Schardt, Joanneum Research

In the current newsletter we are pleased to send out the research results of our EUFODOS partners from the University of Freiburg. They investigated two small storm events in Germany and Poland using SAR and HR optical data. They assessed how fast and at what information quality windfall areas can be derived after a storm event.

In this issue

Contact

Secretariat,
EUFODOS UEB
Stefanie Linser
stefanie.linser@ umweltbundesamt.at

Storm disaster mapping in Germany and Poland

By Matthias Dees and Jörg Ermert, FELIS, University of Freiburg

EUFODOS followed the concept of service development in liaison with users already identified in the beginning of the project. Service level agreements have been concluded with these users on the delivery of EO based information. In case of monitoring of damages the fact that severe storm and biotic damages occur only irregularly with intervals of several years this can restrict the service delivery opportunities based on such agreements. In case of the service provided by GAF AG in cooperation with FELIS to ThüringenForst, AöR in Germany during the project life time only a small area of about 1.5 km² was hit by a tornado in 2012. This small damage case was utilised by FELIS to demonstrate the mapping capabilities of SAR data. FELIS as a research partner had more flexibility in selecting the geographic area. In Northwest Poland in 2011 a storm damaged forests on a relative large area of about 500 km² and FELIS used this opportunity to demonstrate storm damage mapping using optical data.

Storm event in Thuringia

On 05 July 2012 a tornado caused damages near the City of Gera in Thuringia/Germany. Main tree species in that area are Norway spruce, pine, beech and oak. Due to the availability of TerraSAR-X data before the event it was possible to demonstrate the Rush Mode Service capabilities utilising image to image mapping based on TerraSAR-X by ordering post event data (images used taken on 21.06.2009 and 28.07.2012 in high resolution spotlight mode, HH/VV polarisation, incidence angle 39°). The resulting damage map is shown in Figure 1. The minimum mapping unit used was 0.2 ha. Compared with field mapping the object related user and producer accuracy is 87.5%, i.e. the damaged locations could be well detected whereas the delineation quality was pure (below 50%).

Concluding: With the method described, a first and fast determination of damagedlocations is possible within few days after the storm event. Practically this can be offered as a service since Europe is well covered with SAR archive images of TerraSAR and the comparable Cosmo Skymed.

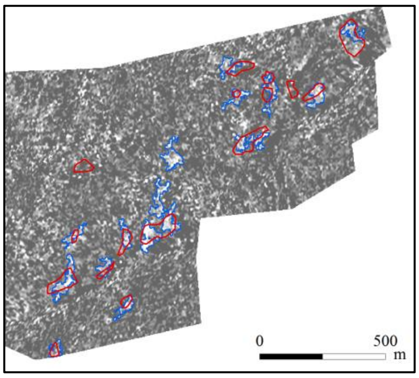

Figure 1: TerraSAR-X image to image backscatter intensity difference with results of the classification (blue) and the ground truth data (red). Damaged areas show increased back scatter (Source FELIS).

A second option was the assessment using single pass interferometry that is based on the simultaneous (bistatic) image acquisition of the two satellites TerraSAR-X and TanDEM-X. Using the surface model generated based on images taken in bistatic mode on 29.07.2013 and subtracting the terrain model based on LIDAR data from the archive, the forest height after the storm was determined and compared to a vegetation height model based on LIDAR from the archive. The results shown in Figure 2 illustrate that this method is highly accurate in object detection and delineation accuracy. Merely a separation of the damaged areas from recent harvesting is necessary to achieve excellent result. This is possible if the user has recorded harvesting. Parallel studies on a test site near Karlsruhe showed that such results can only be achieved with single pass interferometry. While the results achieved in Thuringia have been achieved in summer, parallel studies showed that this option is also feasible in winter with leaf free deciduous trees. The surface model based on data acquired in winter shows a bit lower height than the surface model based on summer data with leaves on, but the accuracy is still sufficient, showing tree cover of substantial height. It has to be noted that an incidence angle of about 45° is recommend-

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 262786 EUFODOS

ed as too small angles can induce face unwrapping problems and larger ones hinder the detection of small damages.

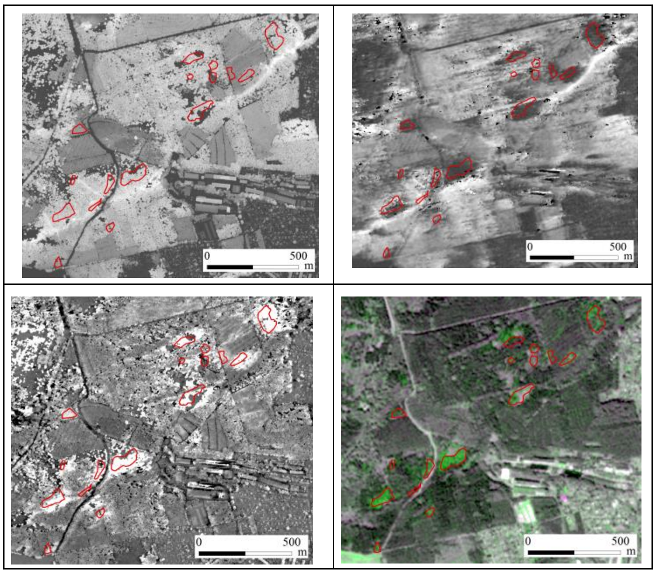

Figure 2: Reference areas overlaid. Top line, left: LIDAR based surface model from 02/2011; right: SAR based surface model from 07/2013. Bottom line, left: Before-after surface model height difference; right: RapidEye data image before-after composite (27.06.2011/24.07.2012 RGB red edge after/before/after) (Source: FELIS).

This application requires a surface model before the storm event of sufficient quality and actuality, either from LIDAR or from the current TerraSAR-X/Tandem-X global digital terrain model mission. For TerraSAR-X/Tandem-X the single pass bistatic mode is ensured up to the end of 2014, data delivery mechanisms are not prepared for fast delivery. 2015 research oriented data acquisition has priority and the use after 2015 is open, thus TerraSAR-X/Tandem-X cannot enable an operational service. Since there is presently no other comparable SAR constellation available and future availability is unsure this storm mapping option cannot be offered as a service.

Storm event in Poland

The storm event which is subject of the study in Poland occurred on 11 September 2011 in the north western part of the country. Forests in the region of Gorzów Wielkopolski were damaged, these are dominated by pure pine forests and deciduous forests dominated by beech and oak. The RapidEye data used in this study for an image to image mapping originate from 01.06.2011 and 01.10.2011. The Polish forest administration provided a forest GIS including data on tree species volume to enable the estimation of damaged tree volumes. The mapping is based on image segmentation utilising a discriminant function based change index. The minimum mapping unit was 0.2 ha. The automatic mapping process was followed by visual enhancement. An intersection with the forest GIS allowed the estimation of the damaged wood volume. The forest management GIS provided by the user was used to map in addition stands with scattered damages smaller than 0.2 ha, using visual interpretation stand by stand. This was done to achieve a realistic estimate of the amount of the damaged wood volume. 464 damage areas were mapped that cover 382.4 ha. In addition, 1,029 forest stands with scattered damages have been classified that cover 3,677.2 ha (see Figure 3). Verification was done using aerial photographs available in Google Earth©. The quantitative results of the verification showed high user and producer accuracy beyond 95%, both for the assessment of damaged areas and stands with scattered damages. This study showed that a regional storm damage event that is dominated by small sized damage areas can be mapped with RapidEye with high accuracy and that the additional assessment of scattered damages is necessary since more than 50% of the damaged wood was damaged in stands with scattered damages. The study further approved the accuracy statements for the optical data based operational service offered by EUFODOS service providers that utilise the Copernicus high resolution forest layer that is necessary in cases where user forest GIS is not available as a forest mask. This is the case for large parts of Europe's forests. This mapping option is thus applicable throughout Europe in the vegetation period and in case of summer storms thus shortly after the damage event.

The close cooperation between FELIS as a research partner and the service provider GAF AG ensures transition of these options to operational services.

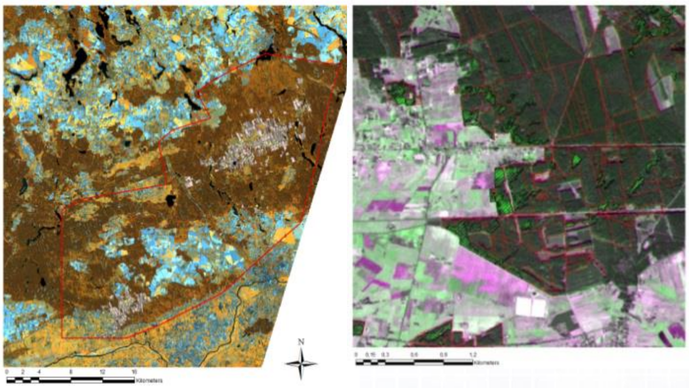

Figure 3: Left: Damage map. Right: Subset (RGB red edge after/ before/after) – damaged areas are bright green (Source: FELIS).

EUFODOS Website
http://www.eufodos.info/