Copernicus Land Monitoring Service

Forest damage detection supported by the HR Forest Layer

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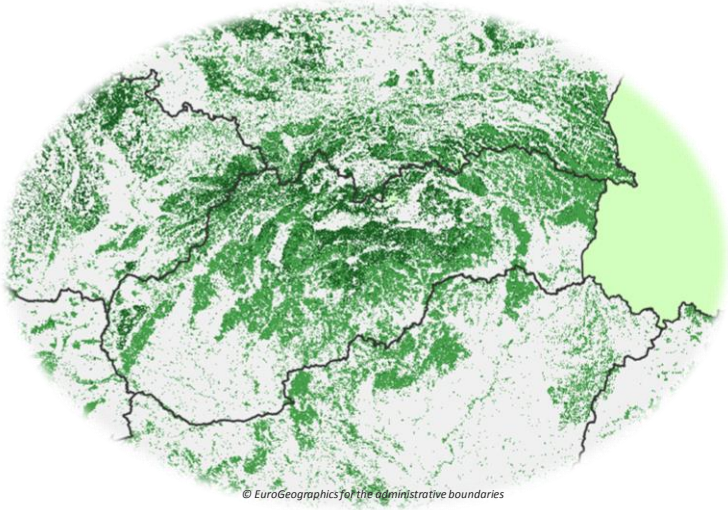
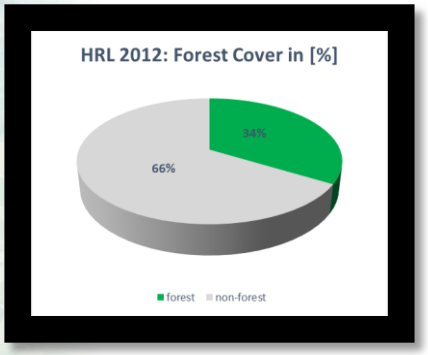
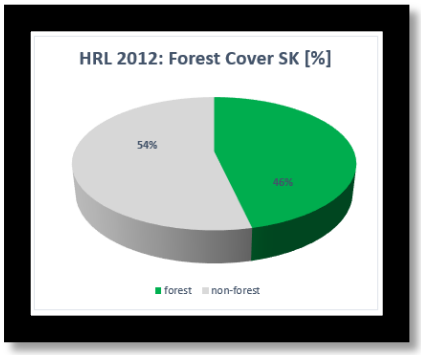
Introduction

- The 20m High Resolution Layer (HRL) Forest provides information on the spatial extent, distribution and characteristics of tree cover for the whole of Europe (EEA-39 countries).







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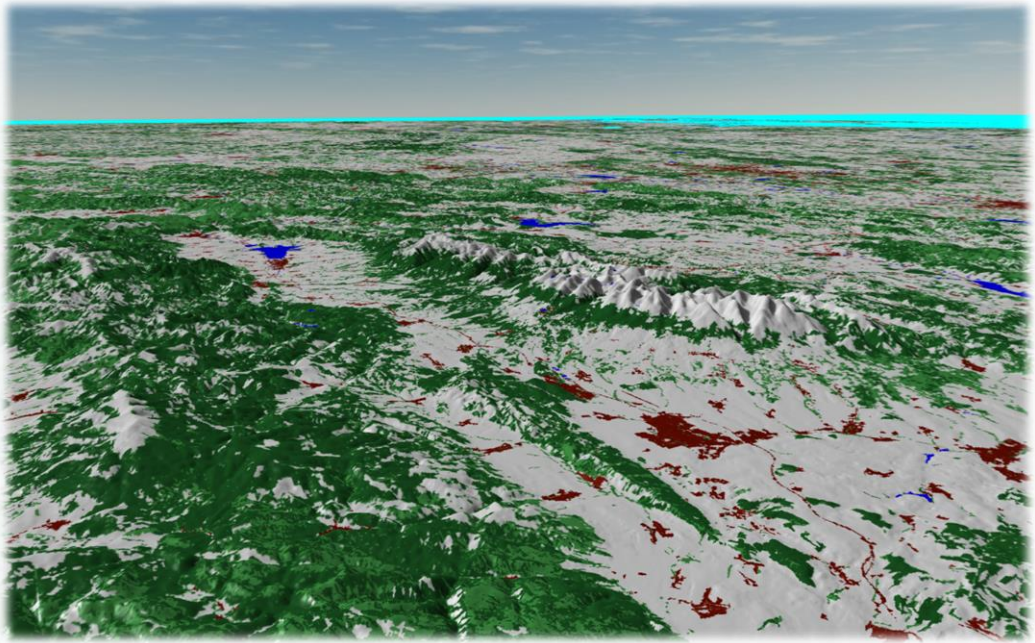
Introduction



3D-View on High Tatras:

- *HRL FTY 2012 (green)*
- *HRL IMD 2012 (red)*
- *HRL PWB 2012 (blue)*
- *EU-DEM (height)*

- This submodule shows how the Copernicus HR Forest Layer can be used to support damage detection in forests.

Introduction

- Damages in managed forests (due to pests, weather or fire) result in a loss of trees and can have large commercial or environmental impacts. Locating and quantifying forest damage at an early stage can limit the losses.
- Concept of forest damage detection
- Making use of Copernicus EO data and the HRL Forest Layer, together with additional pre-/post-event EO observations.
- **Use case:** A German forest owner association wants to assess the damages caused by storm *Niklas* in March/April 2015 nearby Munich.

Source: ICNF, 2011

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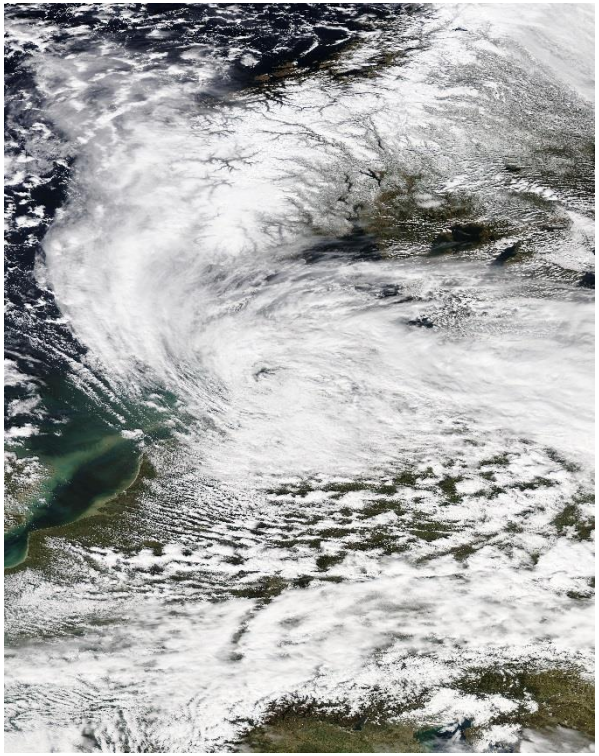
Storm Niklas

- Origin: nearby Iceland
- Duration: 29/03 – 02/04/2015
- Max. wind speed: 192 km/h
- Damage in Germany:
  - Total damage ca. 750 millions EUR
  - Forest damage: ca. 2 millions m^3

Rapid and consequent removal operations of storm-damaged timber by governmental, local and private forestry operations to prevent bark-beetle infestations



NASA - http://lance-modis.eosdis.nasa.gov/cgi-bin/imagery/realtime.cgi

Input Data

- High Resolution Layer Forest
  - Tree Cover Density
  - Forest Type
- VHR True colour Image Mosaic 2012
- Pre- and post-event VHR multispectral satellite data

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Download of Copernicus Forest products (1)

- http://land.copernicus.eu/

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Download of Copernicus Forest products (2)

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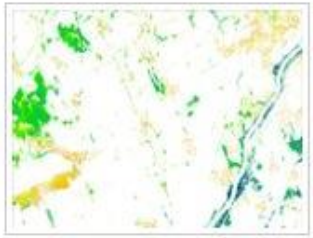
Download of Copernicus Forest products (3)

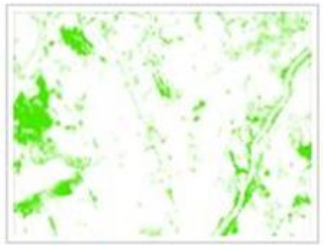
Forests



Tree Cover Density 2012

- 20m pixel-based product
- 0-100% Tree Cover Density
- 2 class categories: all non-tree areas; tree cover

☑	TCD-020m E40N20	Raster	20m	703.8 MB	



Forest Type 2012

- 20m spatial resolution
- 0.5 ha Minimum Mapping Unit
- 10-100% Tree Cover Density
- 3 thematic classes: non-forest, broadleaved, coniferous

☑	FTY-020m E40N20	Raster	20m	131.5 MB	

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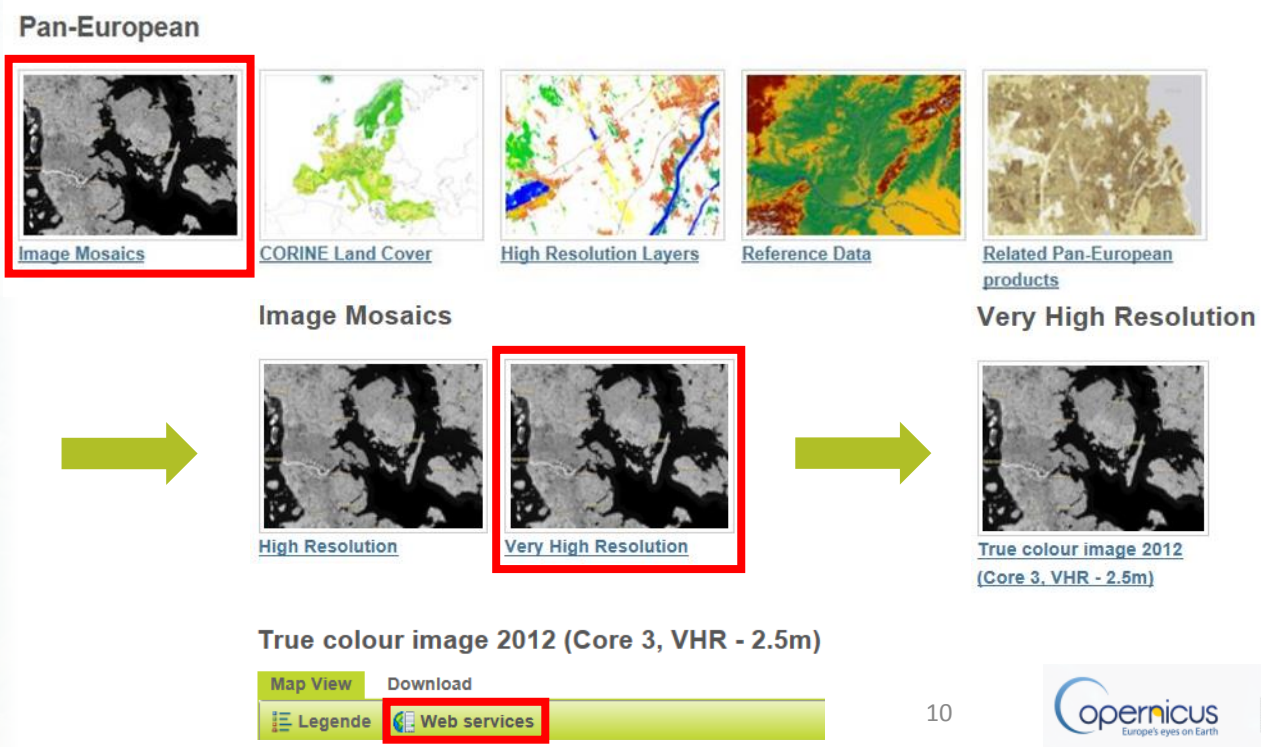
Integrating Pan-European Image Mosaics (1)



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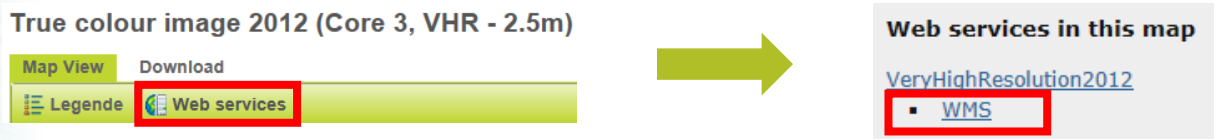
Integrating Pan-European Image Mosaics (2)

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Copy link to add as WMS server to your GIS

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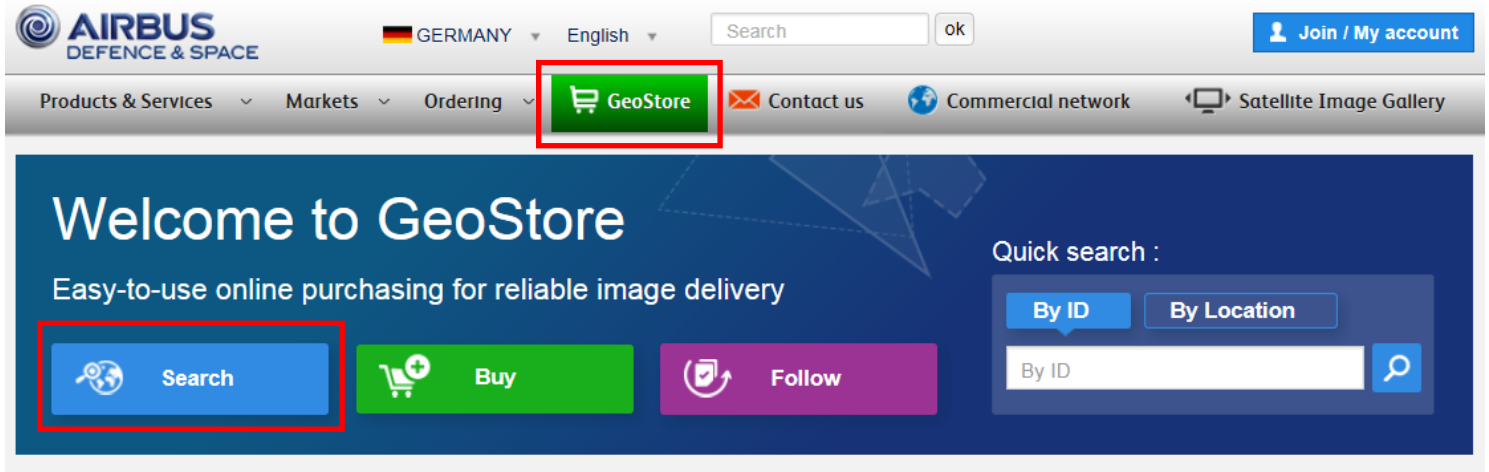
Commercial Catalogue Search: e.g. AIRBUS DS (1)

- http://www.intelligence-airbusds.com/



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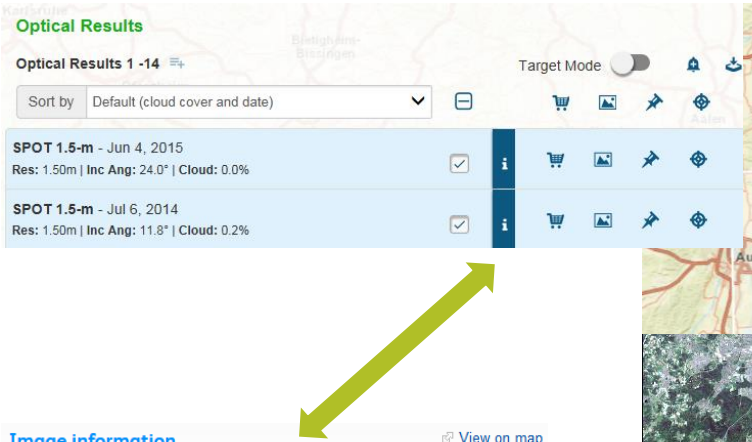
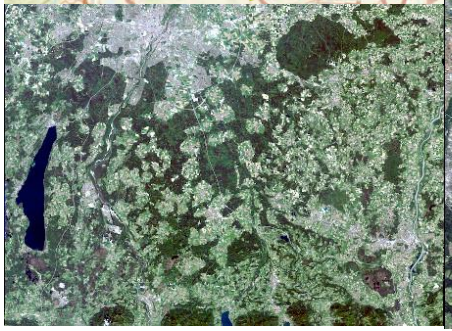
Catalogue Search: e.g. AIRBUS DS (2)





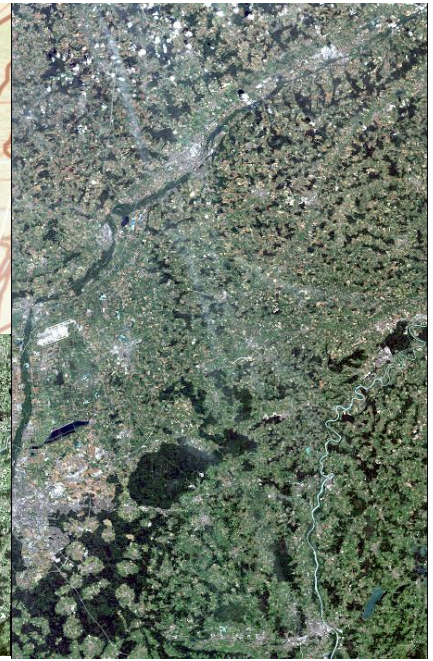


Image information — View on map

Date	2014, July 6th 09:47:39
Cloud Cover	0%
ID	DS_SPOT6_201407060947245_FR1_FR1_FR1_FR1_E012N48_03008
Incidence Angle	11.78562°
Resolution	1.5m
Satellite	SPOT 6
Sensor Family	Multispectral

▸ Detailed information — know more about SPOT 6 products

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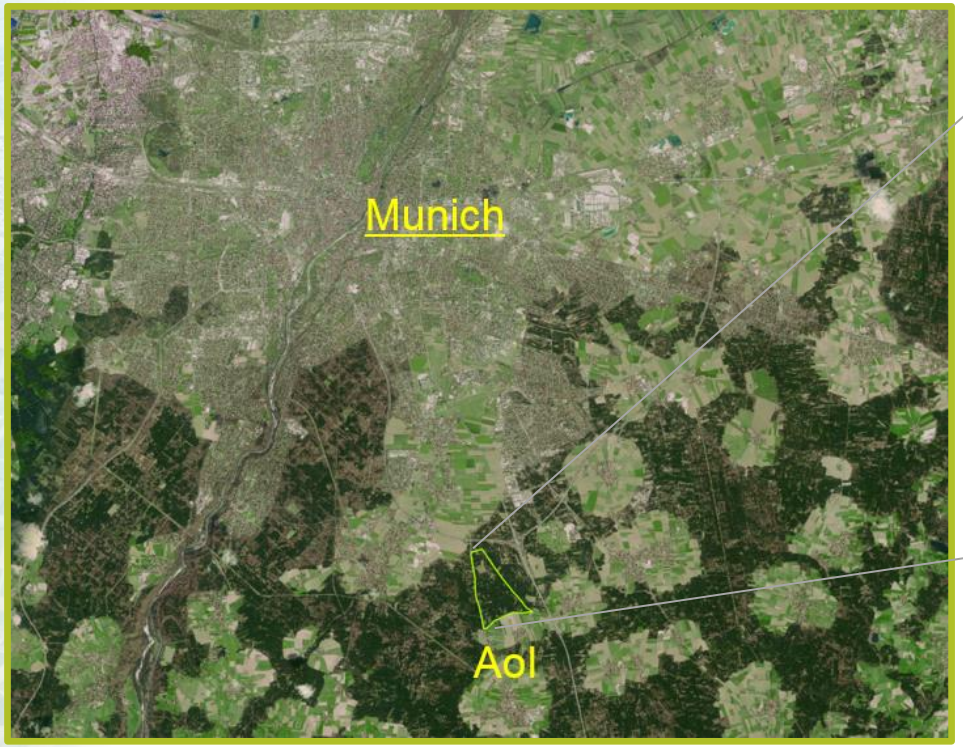
Storm Damage Investigation



Area: 280 ha

True colour image 2012 (Core 3, VHR - 2.5m) WMS overlaid with AoI

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Familiarizing with the Area of Interest (Pre-event)

Tools and Layers:

- Geographic Information System (GIS)
- AoI shapefile
- WMS: CORE_03 2.5m VHR mosaic (true colour)

Adding HRL Forest Information (1)

Tools and Layers:

- Adding 20m pixel-based tree cover mask derived from HRL Forest / Tree Cover Density product

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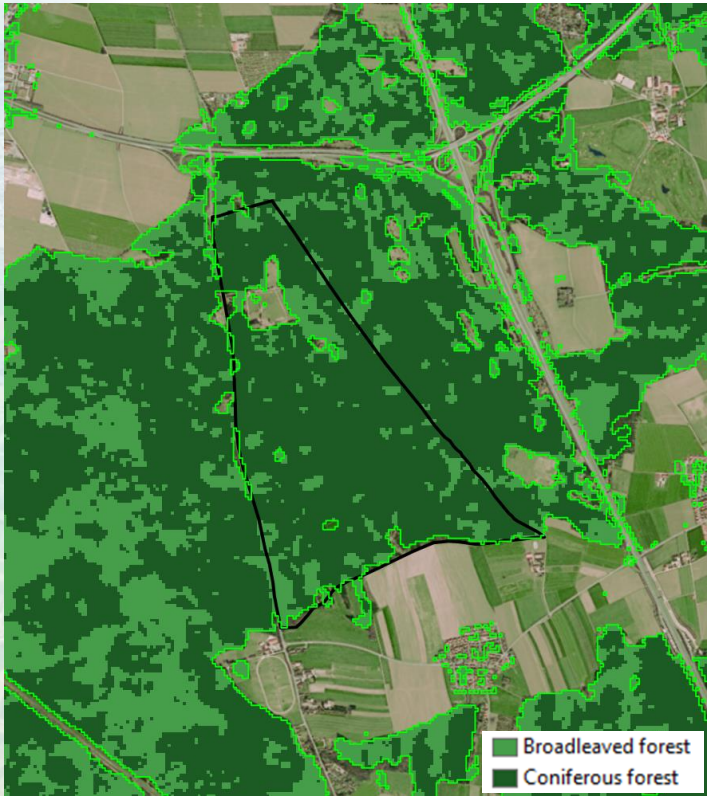
Adding HRL Forest Information (2)



Tools and Layers:

- Adding 20m Forest Type information

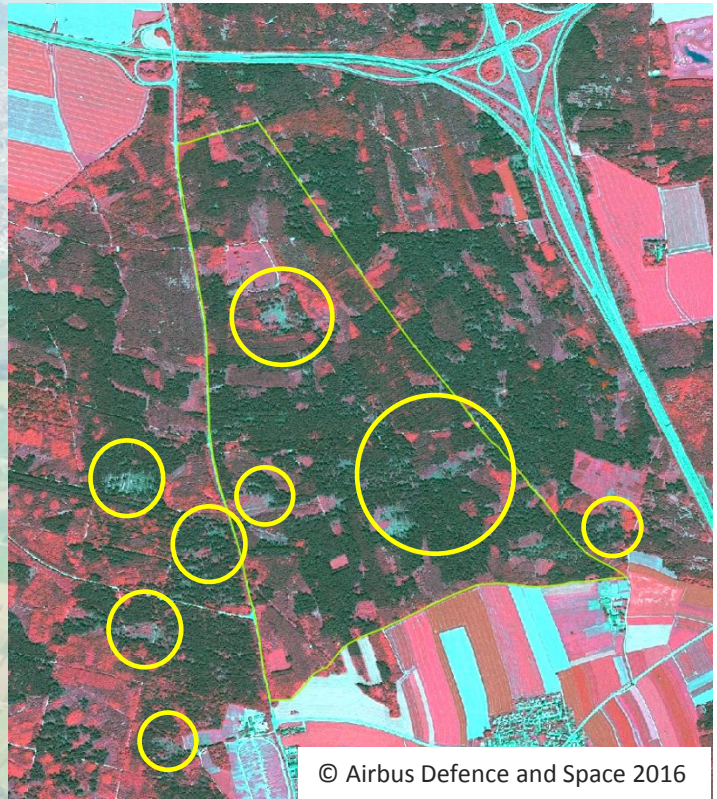
SPOT-6 1.5m VHR Acquisitions

Pre-event scene

- acquired on 2014-07-06
- 1.5m multispectral VHR image
- false colour infrared representation

- Alternative(s): VHR imagery (1-2.5m) from ESA Data Warehouse

SPOT-6 1.5m VHR Acquisitions



Post-event scene

- acquired on 2015-06-04
- 1.5m multispectral VHR image
- false colour infrared representation
- forest damages clearly visible

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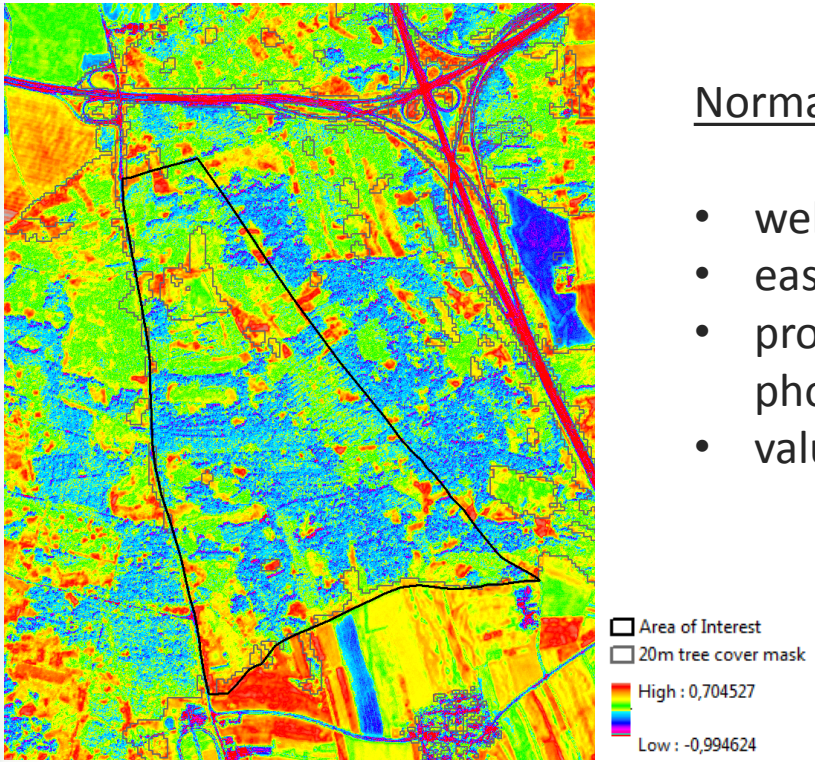
NDVI Calculation – 2015-06-04



Normalized Difference Vegetation Index

- well-established vegetation indicator
- easy to implement and interpret
- provides information on the level of photosynthetic activity
- values range from -1.0 to +1.0

$$NDVI = \frac{(NIR - RED)}{(NIR + RED)}$$

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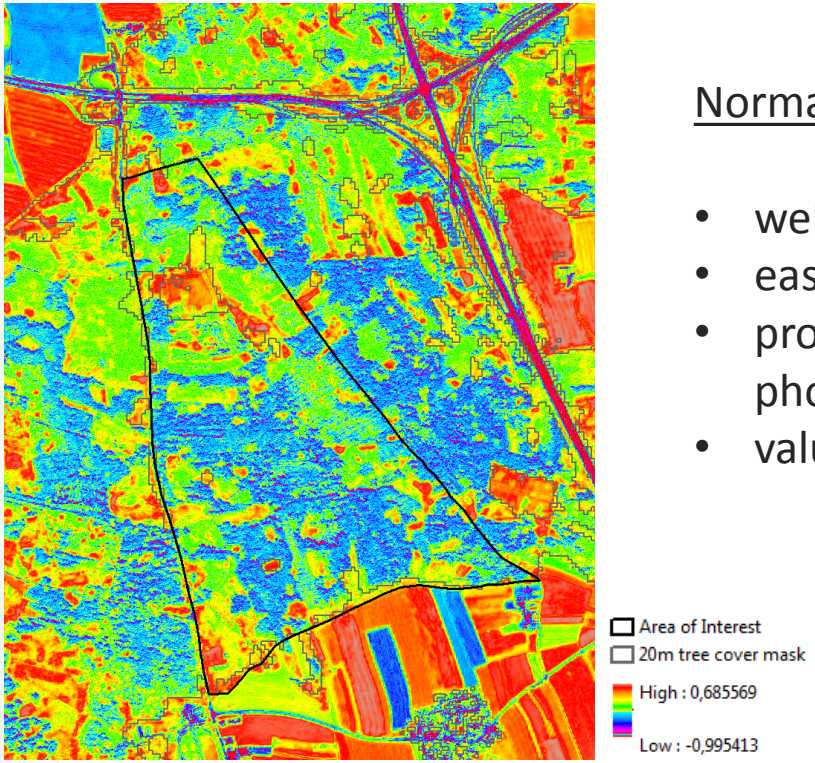
NDVI Calculation – 2014-07-06



Normalized Difference Vegetation Index

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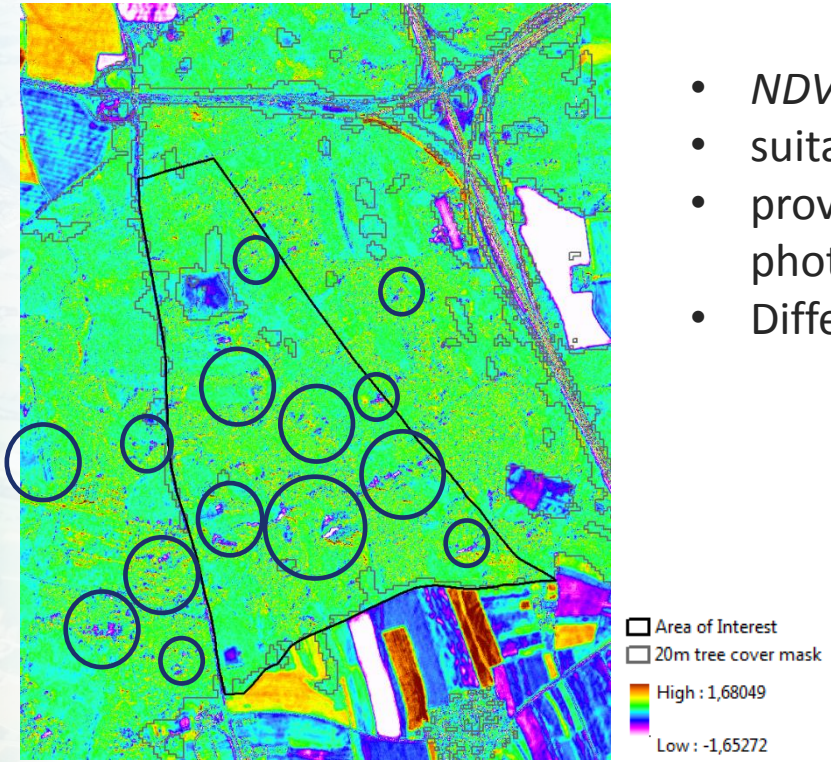
NDVI Difference as Damage Indicator



- *NDVI t_0 – NDVI t_1*
- suitable for rapid change assessment
- provides information on changes within photosynthetic activity
- Difference values range from -2.0 to +2.0

BUT, sensitive to:
- image co-registration
- sensor viewing angles
- vegetation phenology (i.e. good forest mask needed)

Damage Detection Steps – Summary

- Classify forest characteristics (e.g. NDVI, tree cover density) pre- and post-event at VHR resolution
- Difference calculation: forest characteristics $t_0 - t_1$
- Apply size and TCD difference threshold to identify damaged areas
- Intersect changes with tree type information
- Statistical evaluation

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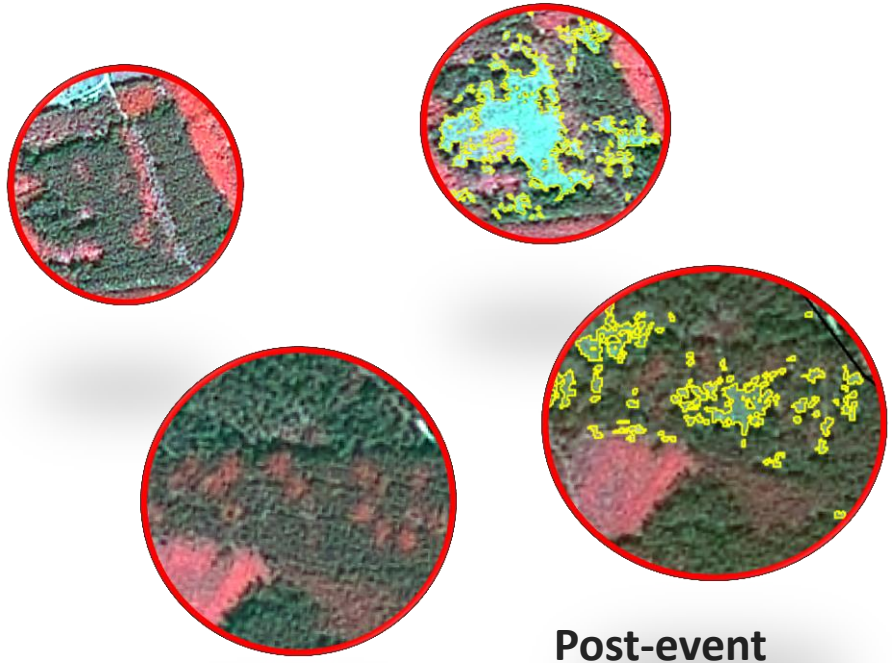
Damage Detection Results



Pre-event

Post-event

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Results

- High Resolution Layer Forest supports identification of forest damages (e.g. storm damages)

Tree Type	Damaged areas	Area [ha]	Area [%]
Broadleaved	138	0.14	2.5
Coniferous	558	5.62	97.5
	696	**5.77**	**100**
Percentage of damaged forest: 2.07%			

Thanks for your Attention

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