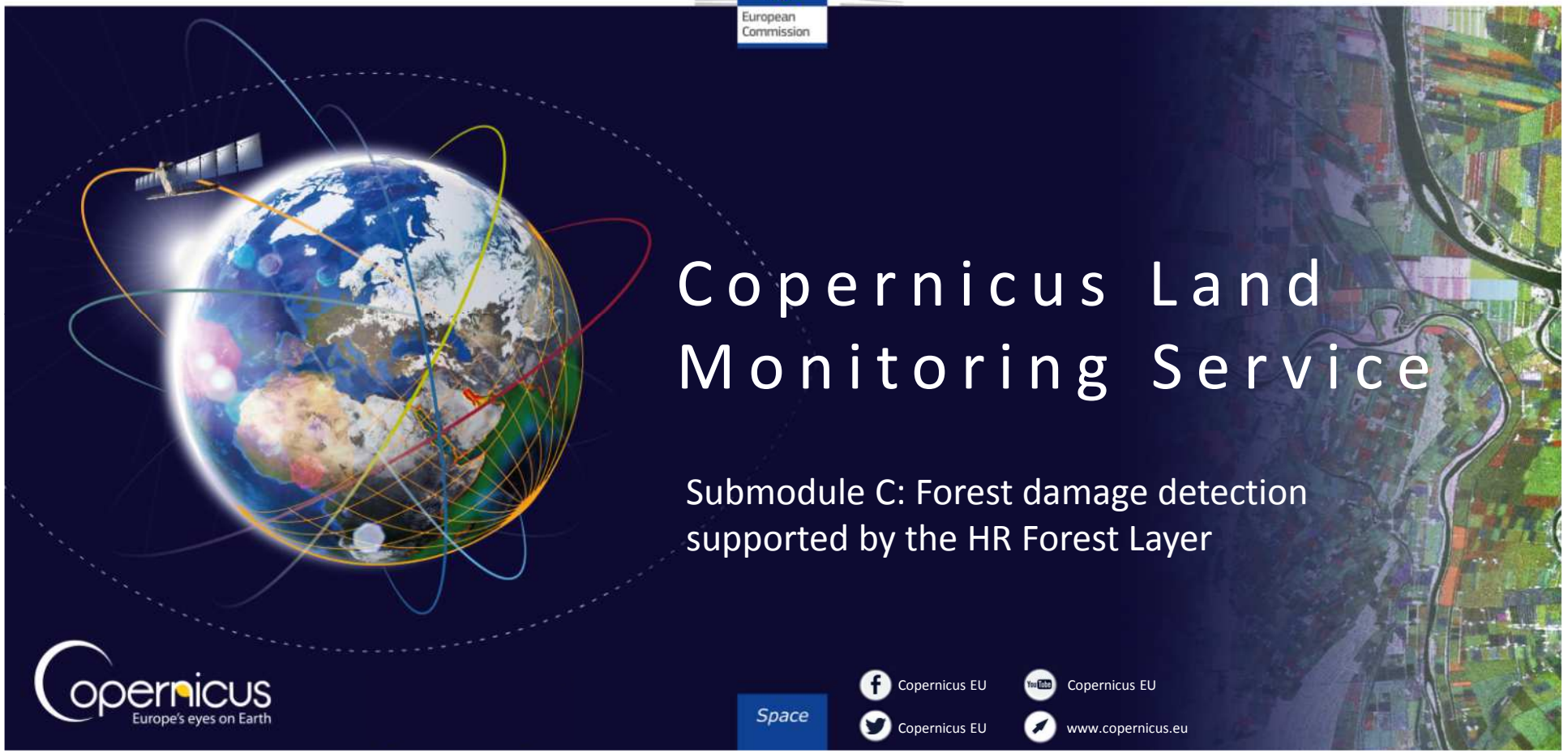
European Commission
Copernicus Land Monitoring Service
Submodule C: Forest damage detection supported by the HR Forest Layer
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Introduction

- The 20m High Resolution Layer Forest provides information on the spatial extent and distribution of tree cover and dominant leaf types for the whole of Europe (EEA39 countries).
- 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.
- This submodule shows how the Copernicus HR Forest Layer can be used to support damage detection in forests.

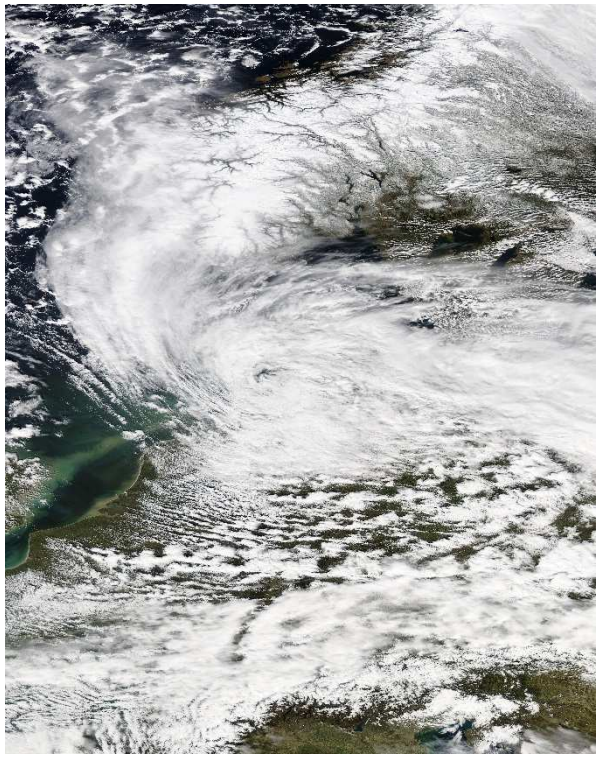
Introduction of Scenario

- A German forest owner association wants to assess the damages caused by storm *Niklas* in March/April 2015 nearby Munich.
- Concept of forest damage detection (related to storm)
- Making use of Copernicus EO data and the HRL Forest Layer together with additional pre-/post-event EO observations.

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 m³

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

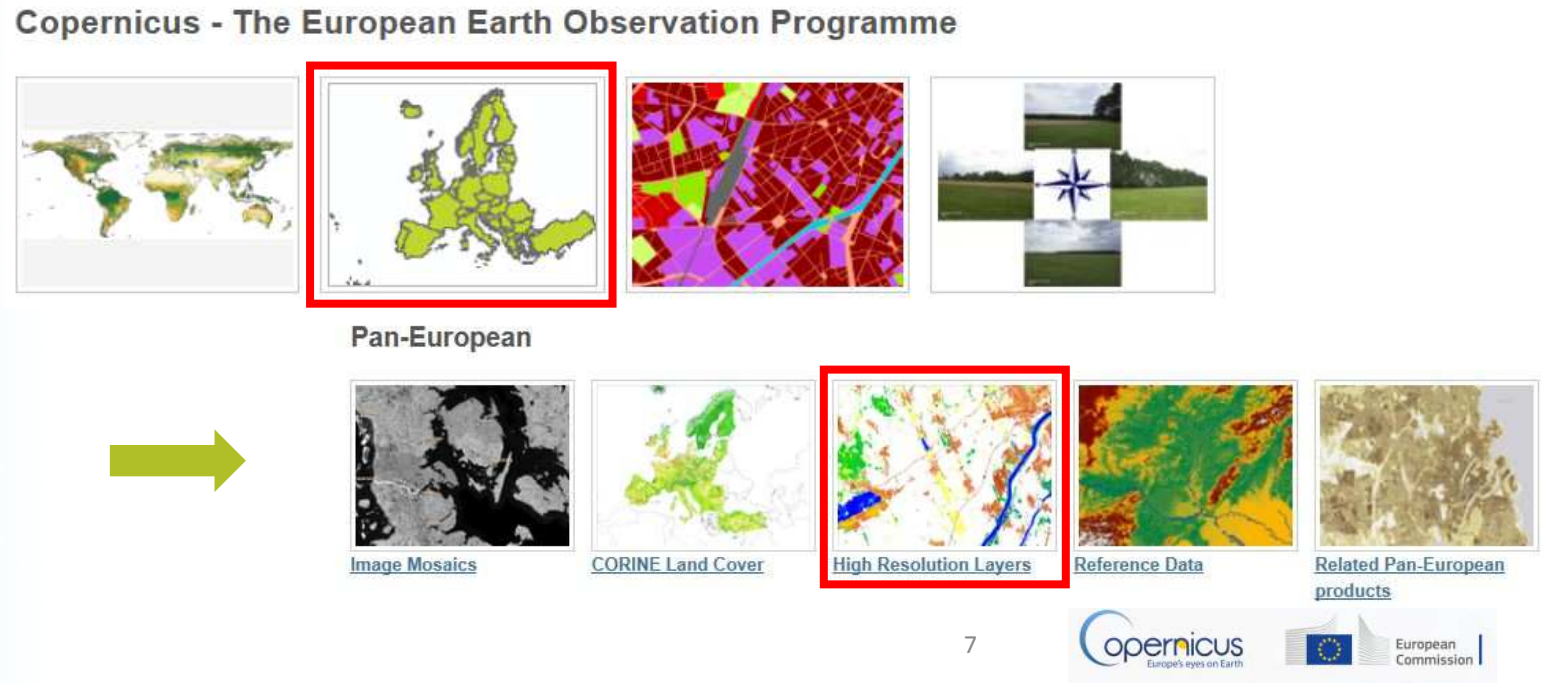
- High Resolution Layer Forest
  - Tree Cover Density
  - Forest Type
- VHR True colour Image Mosaic 2012
- Pre- and post-event VHR multispectral satellite data

Introduction of demonstration

- Download of Copernicus Forest products
- Performing a catalogue search for up-to-date EO data acquisitions
- NDVI calculations
- Classification of the post-event satellite image

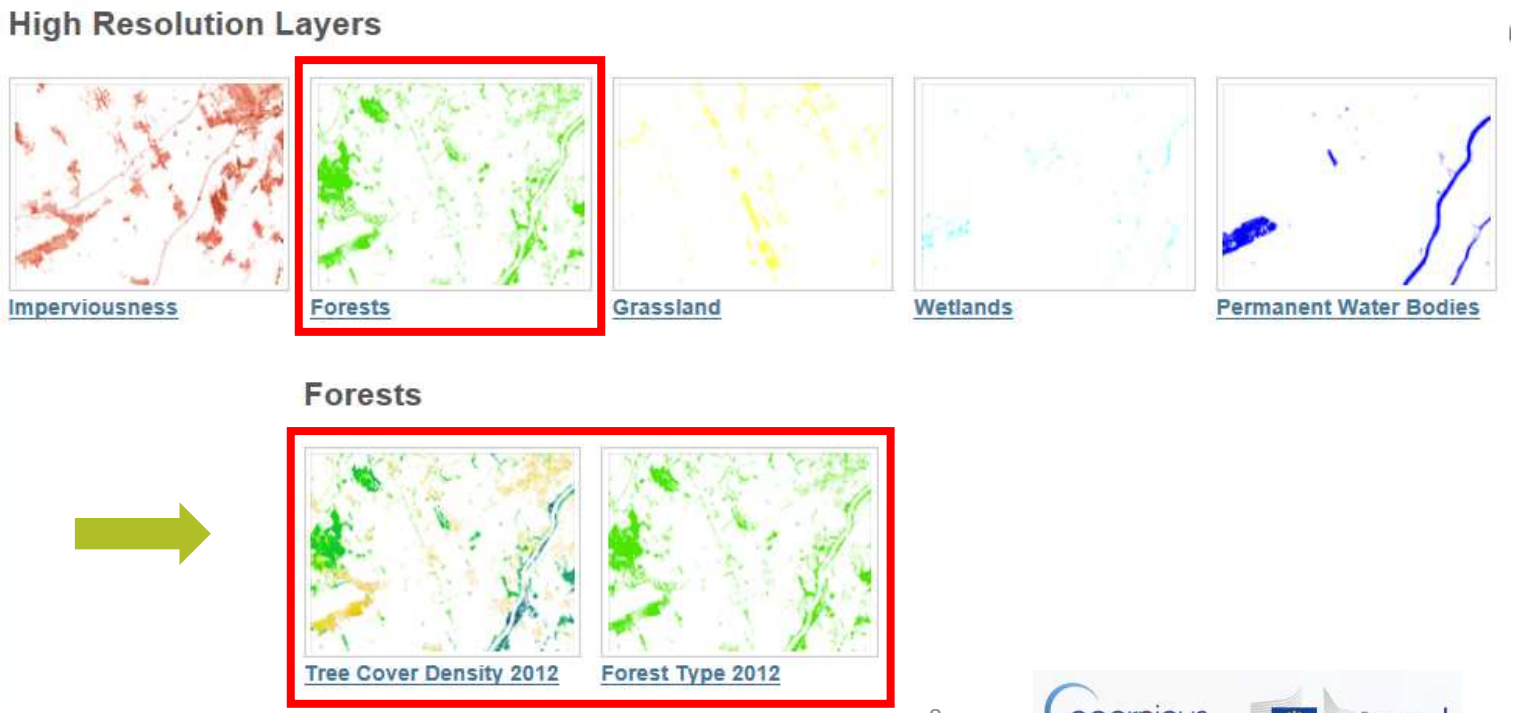
Download of Copernicus Forest products (1)

- http://land.copernicus.eu/



Land Monitoring

Download of Copernicus Forest products (2)



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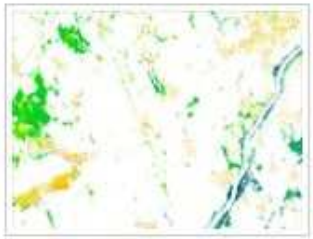
Download of Copernicus Forest products (3)

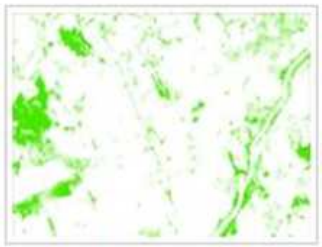
Forests



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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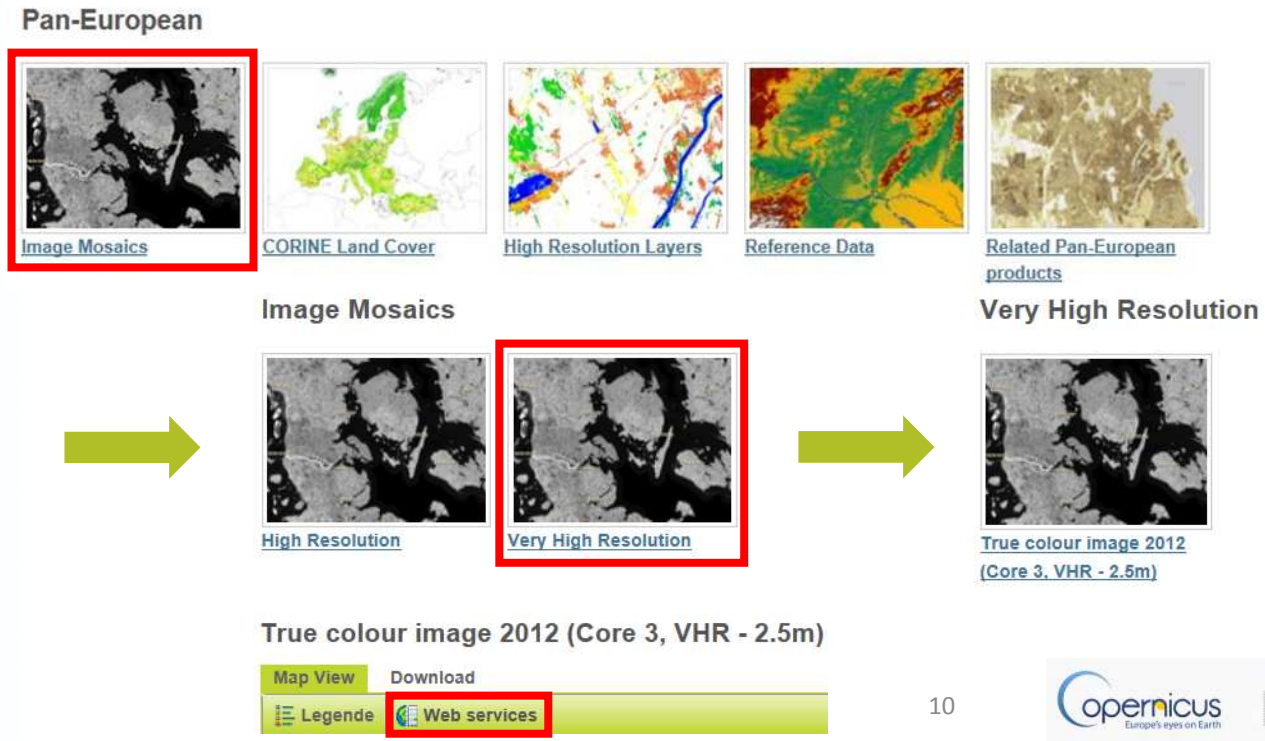
Integrating Pan-European Image Mosaics (1)



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Integrating Pan-European Image Mosaics (2)


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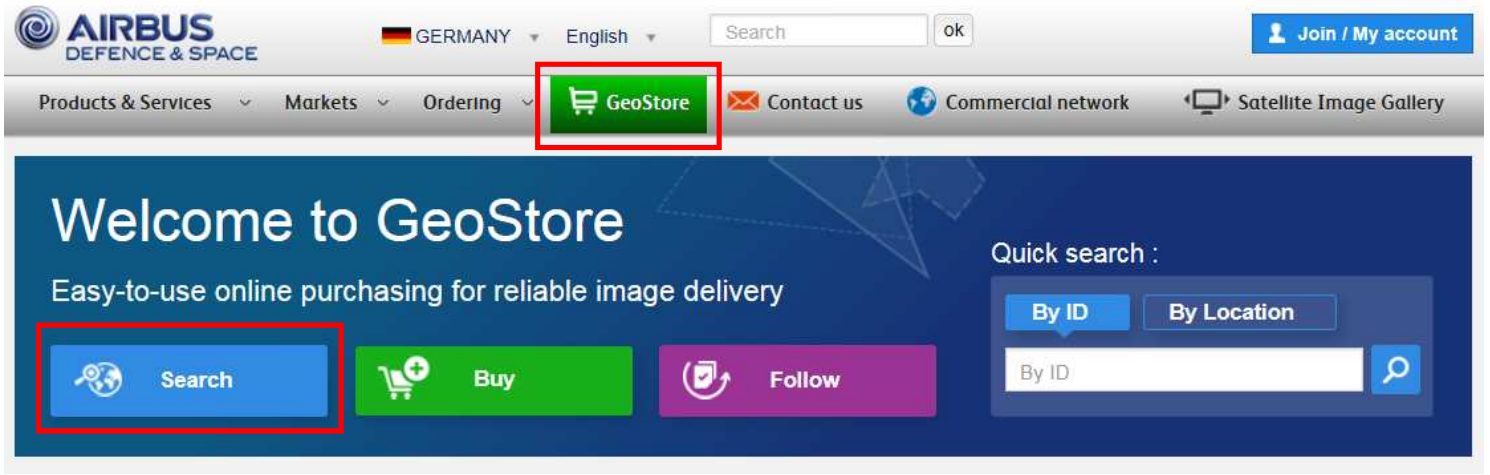
Copy link to add as WMS server to your GIS

Land Monitoring

Catalogue Search: Example AIRBUS DS (1)

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



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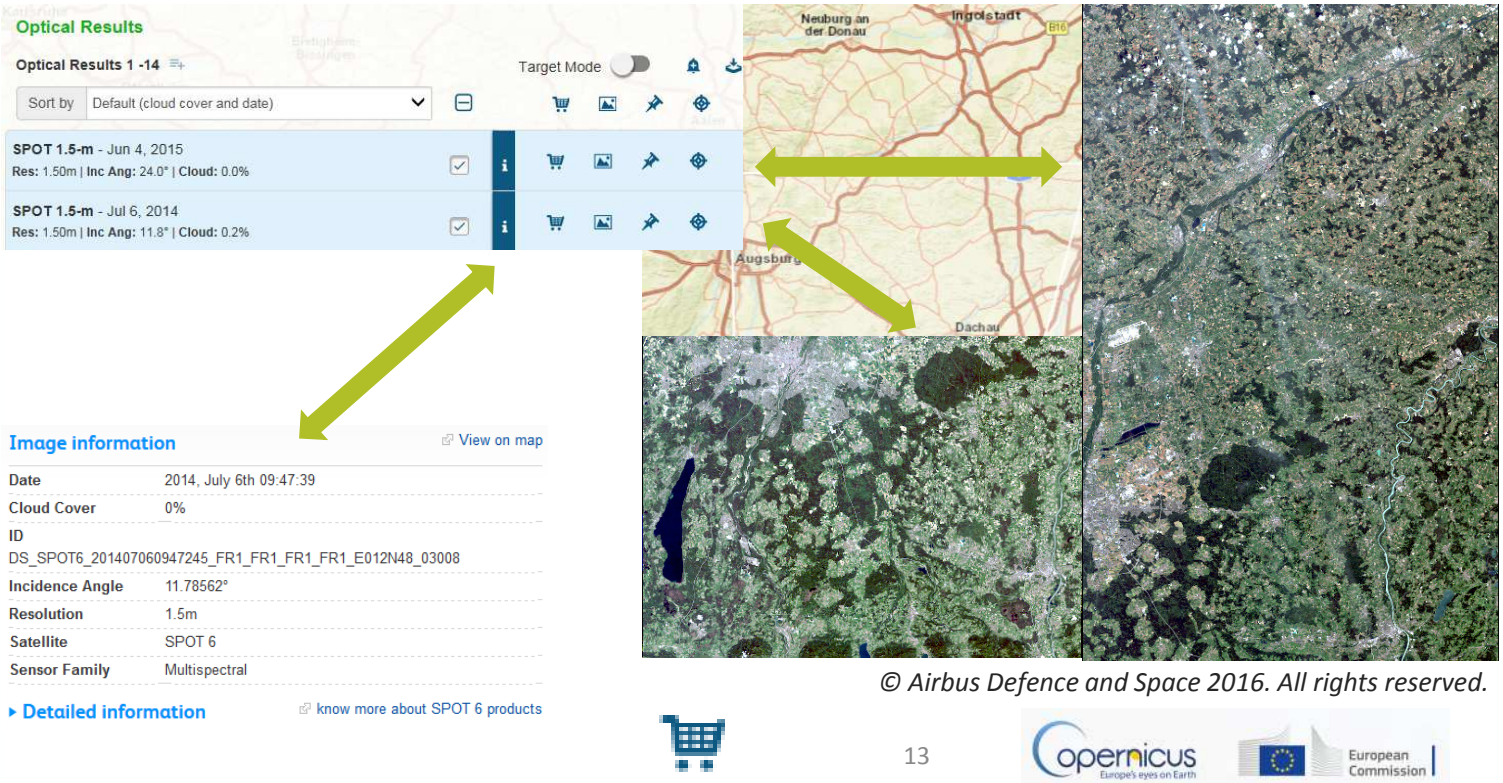
Catalogue Search: Example AIRBUS DS (2)



Storm Damage Investigation

Area: 280 ha

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

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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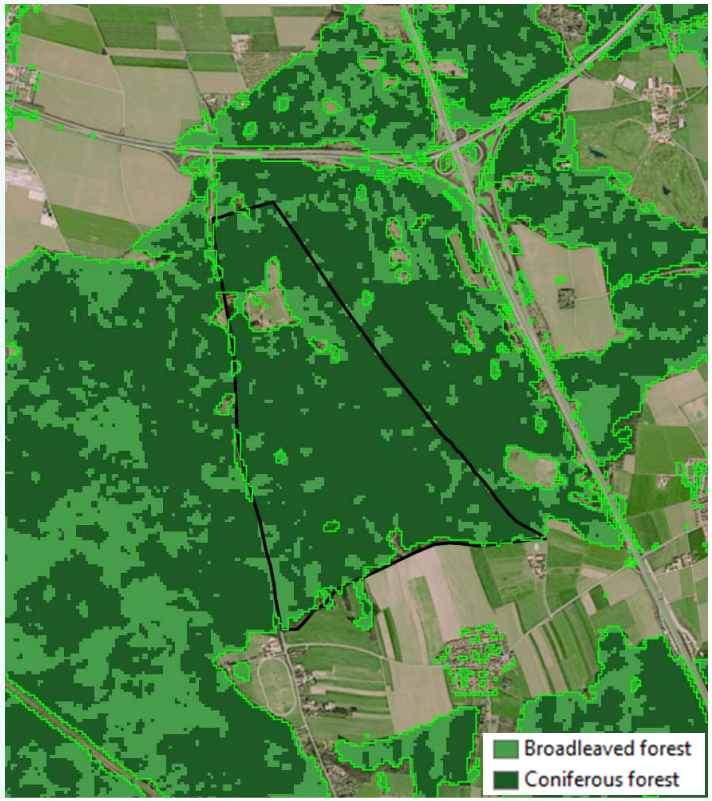
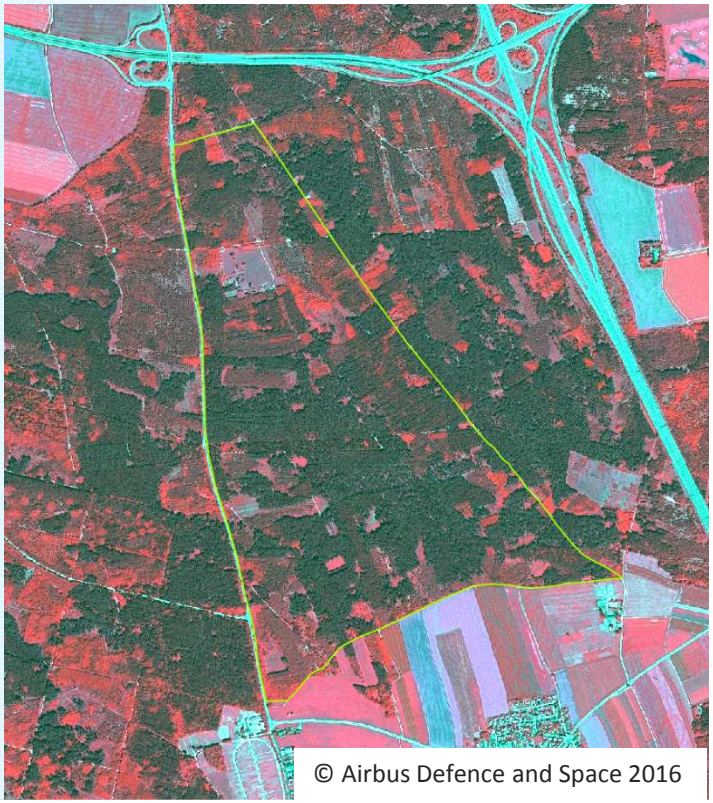
Adding HRL Forest Information (2)



Tools and Layers:

- Adding 20m Forest Type information

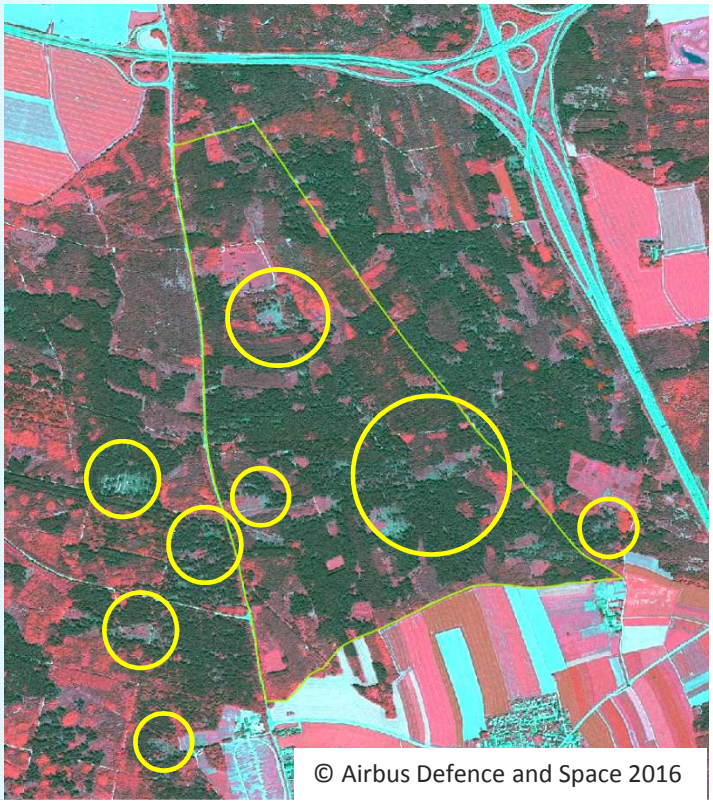
SPOT-6 1.5m VHR Acquisitions



Pre-event scene

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

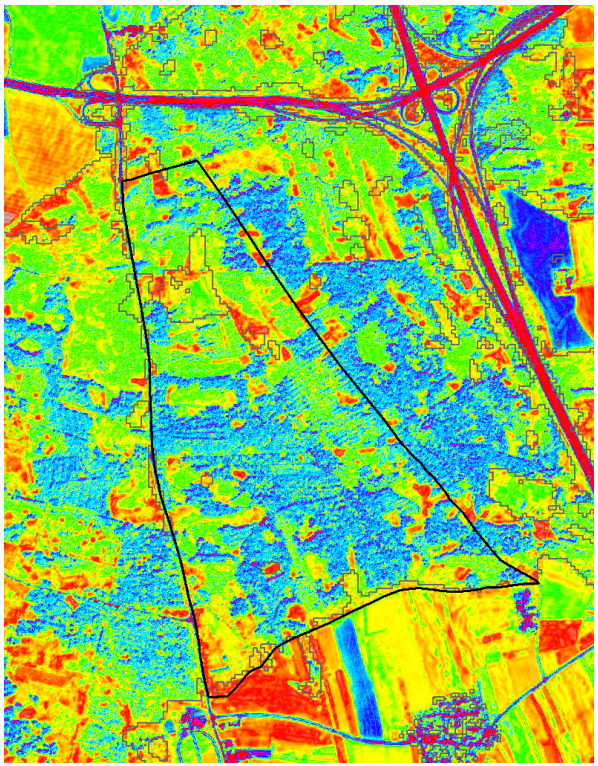
SPOT-6 1.5m VHR Acquisitions



Post-event scene

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

NDVI Calculation – 2015-06-04

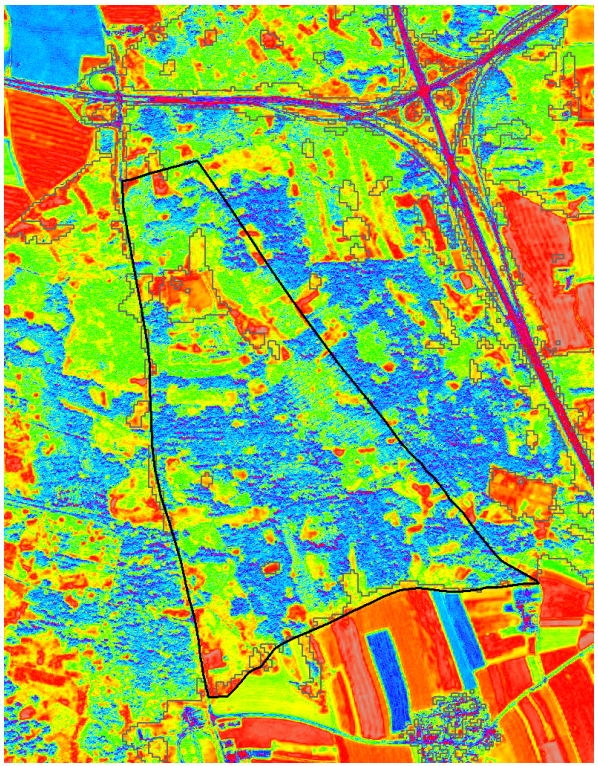


Normalized Difference Vegetation Index

- 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

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

NDVI Calculation – 2014-07-06



Normalized Difference Vegetation Index

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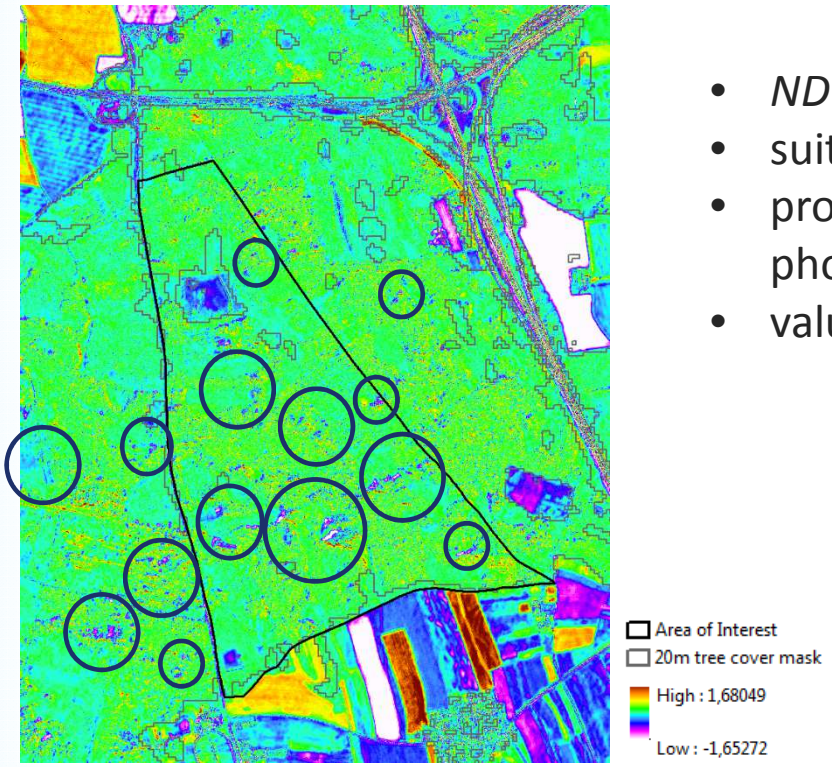
- provides information on the level of photosynthetic activity
- values range from -1.0 to +1.0

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

NDVI Difference as Damage Indicator



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

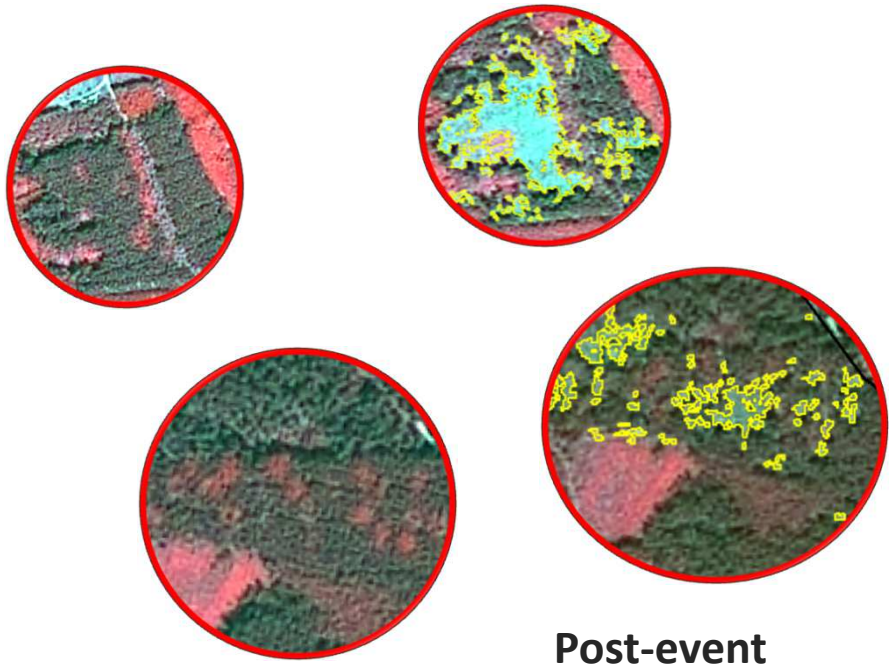
BUT, sensitive to:

- image co-registration
- sensor viewing angles
- vegetation phenology

Damage Detection Steps

- Classify forest characteristics (tree cover density, forest type) pre- and post-event at VHR resolution (trained by 20m HRL Forest)
- Difference calculation: *TCD* t_0 – *TCD* t_1
- Apply size and TCD difference threshold to identify damaged areas
- Intersect changes with tree type information
- Statistical evaluation

Damage Detection Results



Pre-event

Post-event

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%			