

CONFERÊNCIA NACIONAL DE GEODECISÃO

15 | 16
maio
2014

Instituto Politécnico
de Setúbal
ESCOLA SUPERIOR
DE TECNOLOGIA
DO BARREIRO



BLACKBRIDGE – VALUE-ADDED INFORMATION SERVICES AND PRODUCTS FOR AGRICULTURE AND FORESTRY MONITORING BASED ON RAPIDEYE IMAGERY

Dirk TILSNER (Edisoft), Erika Paasche, Alexander Marx (BlackBridge)

EDISOFT

DEFENCE & AEROSPACE TECHNOLOGIES



BlackBridge
Delivering the World

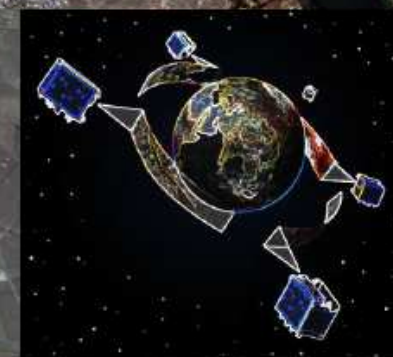
Presentation agenda

- Overview of the RapidEye Observation System
- RapidEye Multispectral Imager
- Agriculture Information Products
- Forest Monitoring Applications
- Conclusions and Outlook

BlackBridge - RapidEye

5

- + identical satellites
- + meter pixel size
- + spectral bands
- + million km² imaged daily
- + billion km² in archive by 2014



Standard Products

 <p>BASIC PRODUCT 1B</p> <ul style="list-style-type: none">+ Radiometric Corrected+ Sensor Corrected+ 6.5 m Pixel Size+ 5 Spectral Bands	 <p>ORTHO PRODUCT 3A</p> <ul style="list-style-type: none">+ Radiometric Corrected+ Sensor Corrected+ Geometric Corrected+ 5 m Pixel Size+ 5 Spectral Bands+ 25 x 25 km Tile Size	 <p>ORTHO TAKE PRODUCT 3B</p> <ul style="list-style-type: none">+ Radiometric Corrected+ Sensor Corrected+ Geometric and Bundle Corrected+ 5 m Pixel Size+ 5 Spectral Bands+ AOI Size	 <p>RAPIDEYE MOSAICS 3M</p> <ul style="list-style-type: none">+ RGB True Natural Colors+ 5m Resolution+ Off-the-shelf or Custom+ Orthorectified+ Radiometrically Color Balanced+ Virtually Cloud Free
---	---	--	--

+ Intermap NEXTMap 30 DSM

Overview of the RapidEye Observation System



DEFENCE & AEROSPACE TECHNOLOGIES



Application areas

<h3>AGRICULTURE</h3>	<ul style="list-style-type: none">MAPPINGPRECISION FARMINGCROP HEALTHPEST INFESTATIONSYIELD FORECASTSTORM DAMAGEMOISTURE CONTENT	<h3>MAPPING</h3>	<ul style="list-style-type: none">LANDUSELANDCOVERCHANGE DETECTIONCARTOGRAPHYMONITORINGMODELLINGGIS
<h3>FORESTRY</h3>	<ul style="list-style-type: none">INVENTORYHEALTHMONITORINGHARVESTINGFUEL AND FIRE RISKBIOMASSCONSERVATION	<h3>ENVIRONMENT</h3>	<ul style="list-style-type: none">MAPPING & MONITORINGLAND USE / LAND COVERCLIMATE CHANGECONSERVATIONWILDLIFE HABITATSWATER RESOURCESURBAN SPRAWL
<h3>ENERGY & INFRASTRUCTURE</h3>	<ul style="list-style-type: none">BROAD AREA MAPPINGGREEN INITIATIVESENVIRONMENTAL IMPACTCHANGE DETECTIONCONSTRUCTION ENCROACHMENTPIPELINE MONITORINGEXPLORATION	<h3>SECURITY & EMERGENCY</h3>	<ul style="list-style-type: none">DISASTER RESPONSEHUMANITARIAN AIDRECOVERY AND REBUILDINGBROAD AREA MAPPINGSURVEILLANCESITUATIONAL AWARENESSVISUALIZATION AND SIMULATION

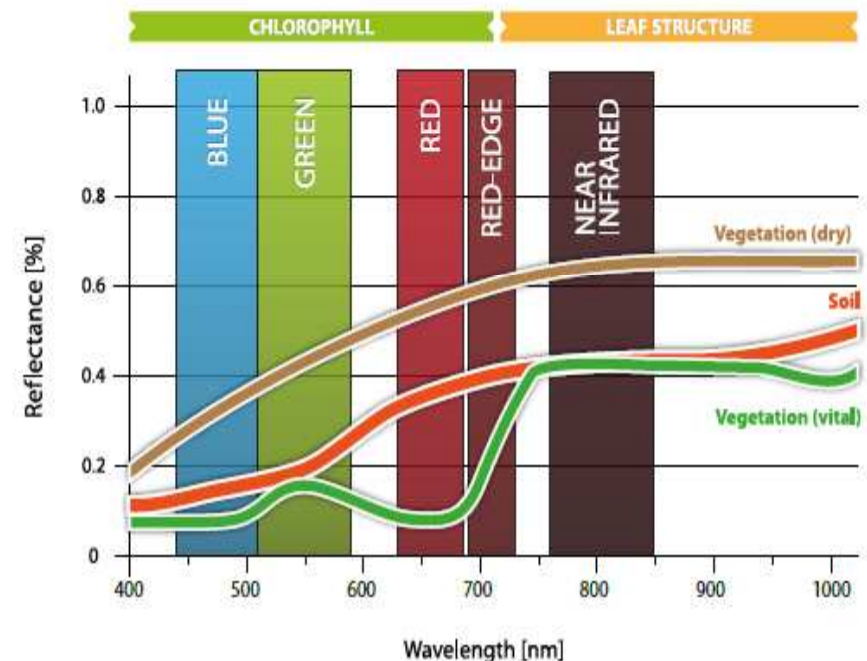
RapidEye Multispectral Imager

Characteristics

- Resolution: 6.5 metre GSD at nadir / 5 metre orthorectified
- Sensor type: multi-spectral push broom imager
- 5 spectral bands:
 - Blue: 410 – 540 nm
 - Green: 520 – 590 nm
 - Red: 630 – 685 nm
 - Red-Edge: 690 – 730 nm
 - Near Infrared (NIR): 760 – 850 nm
- Dynamic range: up to 12 bit
- Revisit time: daily (off-nadir) / 5.5 days (at nadir)

Suitability for agriculture and forest monitoring

- **Red band:** chlorophyll strongly absorbs light
- **NIR band:** leaf cell structure produces a strong reflection
- **Red Edge band:** reflectance drastically increases from the red portion towards the NIR plateau
- Variations in both the chlorophyll content and the leaf structure are often reflected in this band



Overview of vegetation indices using the RedEdge band

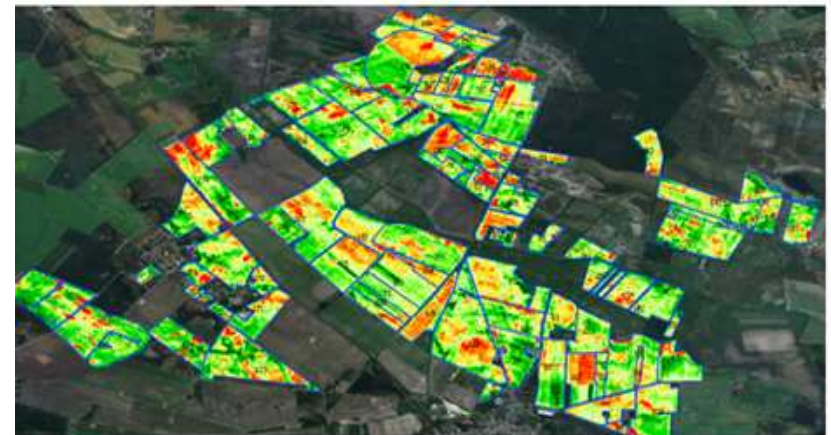
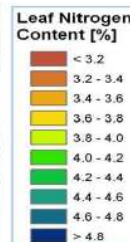
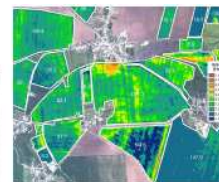
Features	Formula
Ground Cover (GC)	MAAS and RAJAN (2008)*
NDVI	$(\text{NIR} - \text{RED}) / (\text{NIR} + \text{RED})$
NDRE	$(\text{NIR} - \text{RedEdge}) / (\text{NIR} + \text{RedEdge})$
PSRI	$(\text{RED} - \text{GREEN}) / \text{NIR}$
RedEdge chlorophyll Index	$(\text{NIR} / \text{RedEdge}) - 1$
Wetness Index (WI)	$(\text{RED} + \text{GREEN} + \text{BLUE}) / (\text{RedEdge} + \text{NIR})$
Brightness	$(\text{RED} + \text{GREEN} + \text{BLUE} + \text{NIR})$
*slightly modified	

Practical examples

▪ Chlorophyll Map:

- Maps show nitrogen nutrition status of the plants within a field
- exploring the correlation between nitrogen status and chlorophyll content in plants, maps can be used to generate variable nitrogen application maps
- it is further possible to assess the efficiency of previous fertilizer applications and to determine zones with chronic nitrogen deficiencies

Relative chlorophyll content

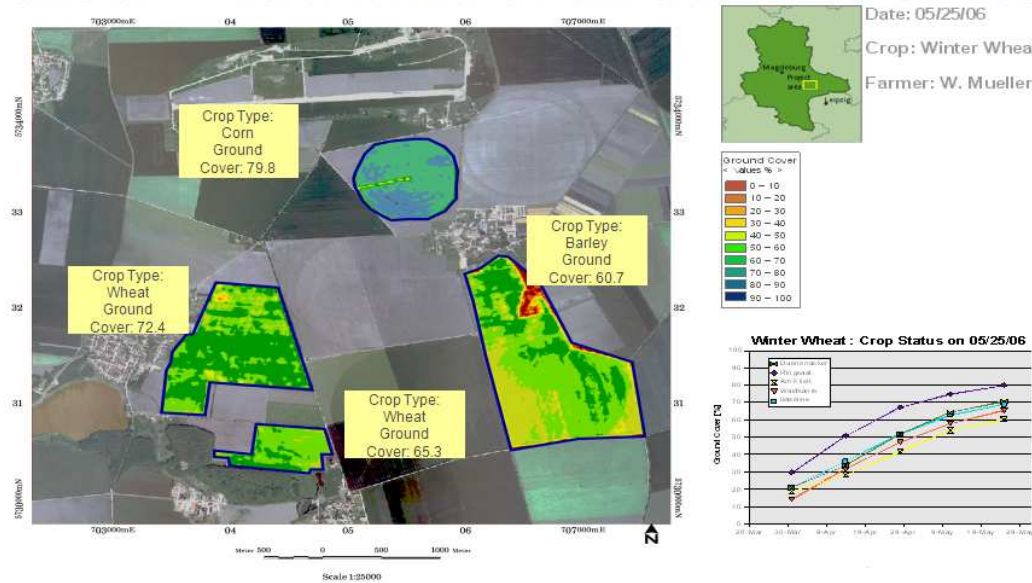


Practical examples

▪ Ground cover map:

- Maps indicate the percentage of ground covered by vegetation (the amount of light reflected (or absorbed) by vegetation and other ground features)
- ground cover is a good indicator of potential productivity and yield
- used to create zones for targeted soil sampling and nutrient management

GROUND COVER MAPS FOR CROP STATUS ASSESSMENT

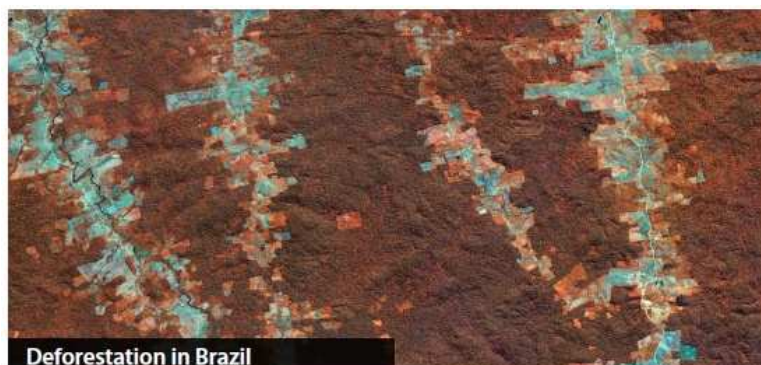


Status of relative Ground Cover (fraction of soil covered by green leaves when seen from above).

The graph below shows the status of the average ground cover of each field over time. Used to determine deviations from the average trajectory.

Overview of applications in forest management

- Biomass assessment
- Forest inventories / forest type classifications
- Monitoring of forest health and vitality
- Law enforcement - illegal logging
- Forest insurance – damage assessment, risk maps etc.
- Forest fires (burn scars)
- Carbon credit trading
- REDD++ (Reducing Emissions from Deforestation and forest Degradation)



Vitality and Change Monitoring Service

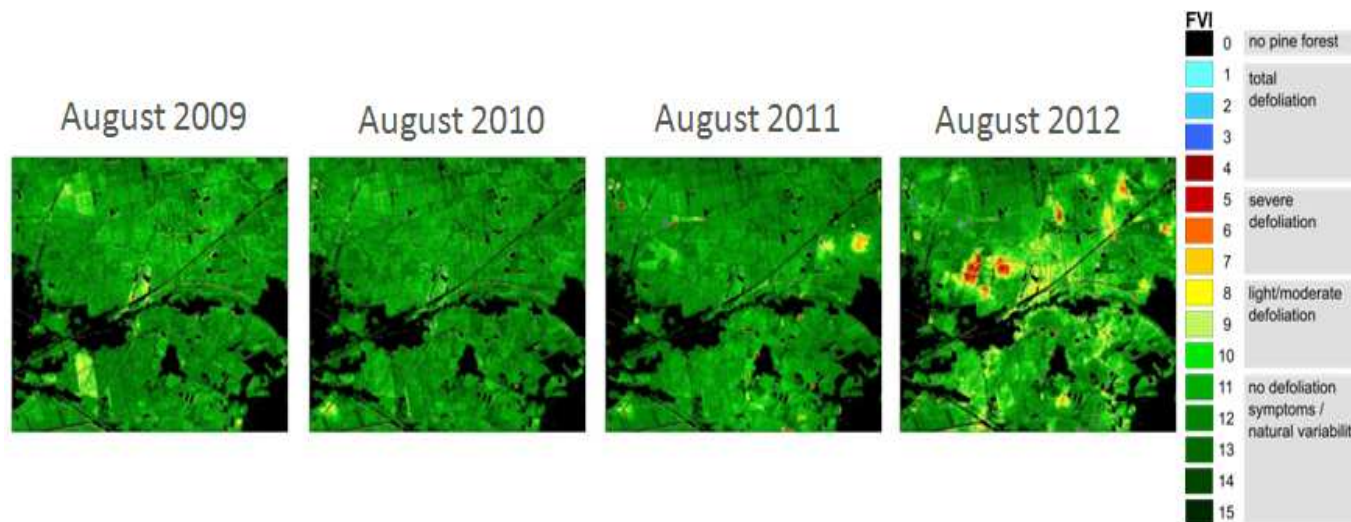
- Forest Downstream Services (FDS) developed under the FP7 EUFODOS project
- based on multi-temporal RapidEye data
- ordered by German State Forest authorities for the monitoring and mapping of forest damages in pine plantations induced by defoliating insects

Approach for detecting and mapping biotic damages

- goal to detect disturbances related to defoliation (in known insect calamity areas)
- use NDRE as a spectral derivative of the NIR band and the Red Edge band:
$$NDRE = (NIR - Red\ Edge) / (NIR + Red\ Edge)$$
- comparative analysis of several years; imagery acquired at the end of the vegetation season (when larva have terminated feeding and pupate)
- calculating binary change (change/no change) and the change magnitude (20 change classes)

Vitality and Change Monitoring - Products

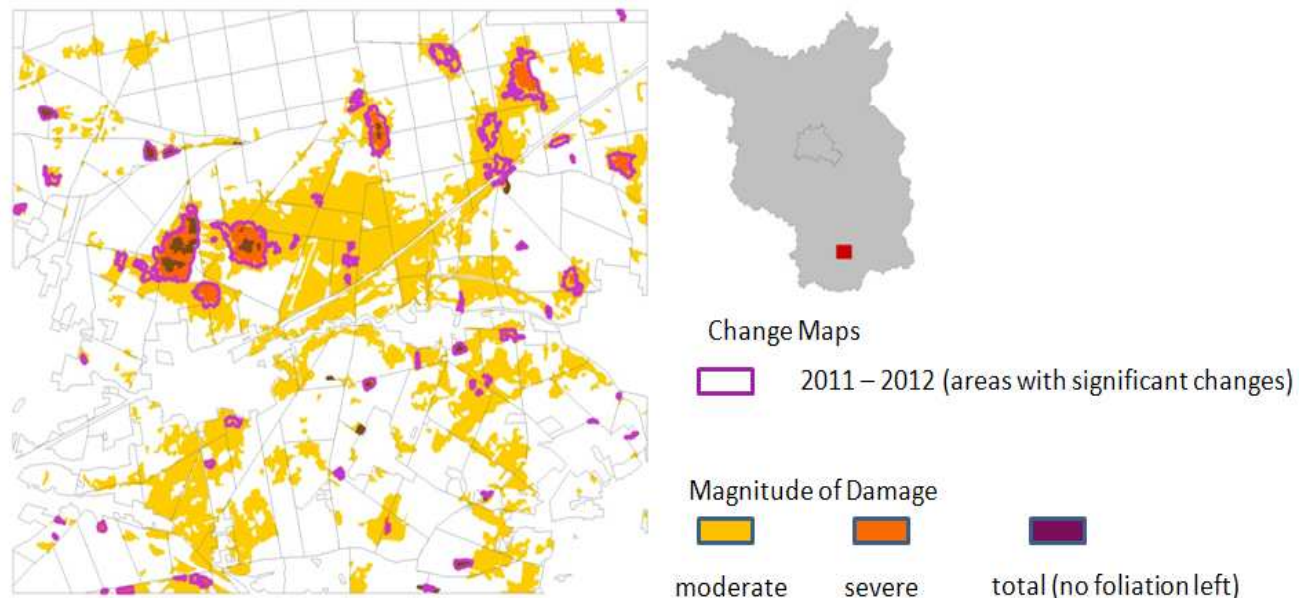
- Relative Forest Vitality
- Change Polygons
- Defoliation Classes



Variation of the canopy vitality due to defoliation (FVC: Forest Vitality Index)

Vitality and Change Monitoring - Products

- change maps are derived which delineate the geographical areas of particularly severely affected sites
- magnitude of damages is recorded in the Defoliation Classes product as 3 defoliation classes: moderate, severe, and total



Change Polygons product overlaid over the Defoliation Classes product (Babben)

Conclusions and Outlook

- RapidEye system ***designed for agriculture and forest monitoring*** applications
- ***Value of the Red Edge band*** corroborated by many studies over the years
- Provided examples of ***new value added products and operational services***:
 - Agriculture:
 - BlackBridge Agriculture Monitoring service with EyeFind Agriculture
 - operational features ideal for monitoring throughout the season
 - Forest Monitoring:
 - Operational Forest Downstream Service (Copernicus)



Obrigado !



DEFENCE & AEROSPACE TECHNOLOGIES

Rua Calvet Magalhães, 245

2770-153 Paço de Arcos

www.edisoft.pt

dirk.tilsner@edisoft.pt



www.blackbridge.com