Belair Workshop
2016,
8 November,
Bruges

Ils Reusen, Koen Meuleman, Kristin Vreys, Bart Ooms, Bart Bomans, Johan Mijnendonckx, Pieter-Jan Baeck, Marian-Daniel Iordache, Tom Verstappen, VITO Remote Sensing
BELAIR 2015 - Objectives

» Organize **spaceborne, APEX and UAV acquisitions**

» Simultaneously perform **in-situ measurements** at
  - “Litora”
  - “Sonia”
  - “Hesbania”

in collaboration with all key users interesting in joining

**Local coordinators** at each of the three sites: Liesbeth De Keukelaere (VITO) @ “Litora”, Boud Verbeiren (VUB) @ “Sonia” and Stephanie Delalieux (VITO) @ “Hesbania”

» **Process, archive and distribute** spaceborne, APEX and UAV imagery and in-situ data to be exploited in MSc and PhD theses and/or running/future (inter)national research projects.
BELAIR 2015 - Kick Off meeting, 20 March 2015 @ BELSPO

» Preliminary APEX, UAV acquisition plans presented and discussed
» APEX and UAV processing presented
» Preliminary field campaign plans discussed
» BELAIR sites discussed and “Sonia” and “Hesbania” sites extended
» Collaboration at BELAIR sites discussed and extended
**BELAIR 2015 - Performance verification**

- Uniform measurement protocol and verification of spectral and radiometric performance of ASD spectroradiometers UCL, VUB and VITO: spectral (Erbium, Mylar), radiometric (synthetic panels, stability)
- A spectral and radiometric verification report including recommendation to clean the spectralon panel before the start of the campaign was provided to UCL and VUB.
BELAIR 2015 - Auxiliary data training

- BELAIR auxiliary data training at VITO on 6 May 2015
- Recommendations/manuals/forms/sample data for pre-processing provided to teams
BELAIR 2015 - APEX calibration

The hyperspectral APEX sensor was calibrated (spectral, radiometric and geometric) at the Calibration Home Base (CHB) hosted by DLR in April 2015.
BELAIR 2015 - APEX Campaign
APEX

APEX data acquisition:
» Hesbania
» Sonia
» Litora

APEX data processing:
» POS data processing
» Image data processing
Hesbania flight

Location, area: St. Truiden - Gembloux, 300 km²

# FLs planned: 5 + 1

# FLs imaged, alt.: 4 + 1, 4200m AGL (FL140)

Date Time: 01/07/2015 1500-1600 LT

Remark: MIL restrictions, last FL aborted

Conditions: ++
Sonia flight

Location, area: Zoniën and Brussels City, 150 km²
# FLs planned: 6
# FLs imaged, alt.: 7, 3350m AGL (FL110)
Date Time: 30/06/2015 1130-1230 LT
Remark: 
Conditions: ++
Litora flight - 2 separate days

**Location, area:** IJzermonding, 10 km²
- **# FL’ns planned:** 1
- **# FL’ns imaged, alt.:** 4x 1, 3650m AGL (FL120)
- **Date Time:** 06/07/2015 1130-1145 LT
- **Remark:** extra heli’s Tour de France - ATC
- **Conditions:** bad

**Location, area:** Lage Moere, 40 km²
- **# FL’ns planned:** 5
- **# FL’ns imaged, alt.:** 5, 3650m AGL (FL120)
- **Date Time:** 30/06/2015 1050-1115 LT
- **Remark:** flown just before Sonia
- **Conditions:** ++ blue sky

**Location, area:** ‘t Zwin, 12 km²
- **# FL’ns planned:** 2
- **# FL’ns imaged, alt.:** 4x 2, 3650m AGL (FL120)
- **Date Time:** 06/07/2015 1155-1245 LT
- **Remark, conditions:** as IJzermonding
BELA 2015 - APEX
processing and delivery
APEX data processing

Determine:
- APEX sensor geometry
- APEX spectral characteristics

Process:
- Raw digital numbers to at-sensor radiances
- Image & system metadata

Perform:
- Differential correction of GPS (position) data
- Blending of GPS (position) and IMU (orientation) data
- Boresight calibration

CDPC L2 processing chain:
- Geomodelling
- Atmospheric correction
- Spectral resampling
- Projection

Colibri:
- spectral smoothing
APEX data delivery

Hyperspectral data cubes of 5 flight lines (Lage Moere only)
Available on BelAir FTP-server 
ftp://cvbftp.vgt.vito.be
folder ‘litora’

Hyperspectral data cubes of 5 flight lines
Available on BelAir FTP-server 
ftp://cvbftp.vgt.vito.be
folder ‘hesbania’

Hyperspectral data cubes of 7 flight lines
Geometrically corrected using AGIV DHMVII DTM/DSM @ 1m
Available on BelAir FTP-server 
ftp://cvbftp.vgt.vito.be
folder ‘sonia’

Litora
Data delivery: 07/12/2015

Hesbania
Data delivery: 06/11/2015

Sonia
Data delivery: 02/11/2015
APEX quicklooks 2015 - Litora - Lage Moere
APEX quicklooks 2015 - Hesbania
APEX quicklooks 2015 - Litora - IJzer
APEX quicklooks 2015 - Litora - Zwin
LITORA-Lage Moere
HESBANIA
SONIA
BELAIRM 2015 - UAV Campaigns
Ebee platform was used combined with multiple payloads:

- RGB
- Red Edge Camera
- Multispec 4C

» Hesbania

- Gembloux area’s (several flights, 75 datasets acquired on several dates)
- Sint-Truiden/PC fruit (5 acquisitions between May and Sept, RGB, Re and Multispec datasets)

» Litora

- Zwin (11/07/2015, 6 flights Re, Multispec)
- Lage Moere (30/06/2015, 5 flights Multispec)
- Nieuwpoort (10/07/2015, 7 flights, Multispec)
UAV data processing

» **What:**
  » datasets acquired with the Ebee platform
  » Multiple sensor datasets: RGB, Red Edge and Multispec 4C
  » End products are orthophoto mosaics per band or combined
  » Digital Surface Model
  » Metadata: camera calibration report, kml, quality report

» **How:**
  » Huge amount of data which was acquired was overwhelming (also) for VITO → New approach needed!
  » Data acquisition over difficult area’s e.g Nieuwpoort (lessons learned!)
  » Multispec data processed with Pix4D (PostFlight Terra 3D)
  » Re, RGB data processed through **automated** chain via Photoscan
UAV data processing: Ortho and DSM
UAV data processing:

Lage Moere
Multispec bands:
NIR
Green
UAV data processing:

Nieuwpoort
Multispec bands: NIR
UAV data processing:

Zwin bands: Red Edge
BELAIR Data distribution
BELAIR 2015 - Data policy

» **Satellite data** purchased by BELSPO (Pléiades, ASTER, DMC, …) remain property of BELSPO

» **Airborne APEX & UAV** (RGB, Multispectral and/or Red-edge) imagery acquired over HESBANIA, LITORA and SONIA and in-situ data are released stepwise, depending on user type:
  » All Remote Sensing (RS) data immediately and free-of-charge available to all participating Users. In-situ field data available upon request to the owner of the data, i.e. to the lab which actually acquired the field data
  » Two years after delivery of the APEX data to the PI, all BELAIR data available to the entire international Scientific Community. The APEX data was delivered to the PI in November-December 2015.
BELAIR 2015 - Data distribution

- Secured FTP-directory for project partners
- Owncloud and metadata for distribution through BELAIR geoportal
BELAIR - GEOPORTAL


» Web based portal to **discover** available (heterogeneous) data and metadata, **view** data, **download** data via Owncloud or FTP/PDF (for APEX) when applicable

» **Manual for data providers**
Easy filter on campaign, type of data, ...

List of ‘matching products’ with:
- Abstract, date, ...
- Link to download (incl. documents)
- Link to view data
- ...

Detailed metadata

View data on map (where applicable)
FOR APEX:
SUPPORTED BY ‘PRODUCT DISTRIBUTION FACILITY (PDF)’

http://www.vito-eodata.be
METADATA AND DATA

» Providers should provide metadata and data
  » Manual for BELAIR data providers available at BELAIR GEOPORTAL
BELAIRE 2015 - Survey
BELAIR 2015 - Survey and Future

» BELAIR Survey October 2016
  ▪ feedback on what went right/wrong during the preparation phase, campaign and post-campaign
  ▪ recommendations for improvements

» Further discussion on future directions of BELAIR, 8 Nov 2016, Bruges
Q1: BELAIR is of interest to you for

» Answered: 16   Skipped: 0
Q2: Which BELAIR site is of interest to you?

» Answered: 14   Skipped: 2
Q6: Is your spectroradiometer calibrated in the last 12 months?

» Answered: 13   Skipped: 3
Q7: Do you have a need for spectroradiometer calibration verification by VITO?

» Answered: 13  Skipped: 3
Q8: Do you have a need for training in field measurements (GPS, spectroradiometer, sun photometer) supporting the image processing

Answered: 14  Skipped: 2
Q9: How important is a sampling strategy of field measurements for your research?

» Answered: 15   Skipped: 1
Q10: Have you developed a sampling strategy for your field measurements?

» Answered: 14   Skipped: 2
Q11 Describe briefly your sampling strategy. Did you follow an existing protocol? Which one?

- Stratified random sampling approach
- Validation of fcover, fAPAR, LAI for 3 fields based on UAV and field measurements (DHP): DHP every 20 rows and 40 steps within selected row
- Protocol to measure bright and dark targets for APEX processing
- 2-3 replicas for soil samples
- For each plot (8x8m) we consider 16 sub-pixels (2x2m) for which we perform measurements (spectra, LAI, soil moisture, etc.) which can be aggregated to have a representative measurement for the plot.
- 2 protocols for taking hemispherical pictures for fCover, fAPAR,… validation: standard sampling (INRA guidelines) for BELCAM, more dense sampling for iPot (focus on intra-field variability)
Q12: If you answered "no", would you need expert support for developing a sampling strategy?

» Answered: 3   Skipped: 13
Q14: How satisfied are you with the preparation of the

» Answered: 13    Skipped: 3

<table>
<thead>
<tr>
<th></th>
<th>0%</th>
<th>20%</th>
<th>40%</th>
<th>60%</th>
<th>80%</th>
<th>100%</th>
<th>N/A</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference field measurements</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>33.33%</td>
<td>33.33%</td>
<td>33.33%</td>
<td>12</td>
</tr>
<tr>
<td>Thematic field measurements</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>33.33%</td>
<td>25.00%</td>
<td>41.67%</td>
<td>12</td>
</tr>
<tr>
<td>APEX campaign</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>15.38%</td>
<td>53.85%</td>
<td>7.69%</td>
<td>23.08%</td>
<td>13</td>
</tr>
<tr>
<td>UAV campaign</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>16.67%</td>
<td>25.00%</td>
<td>16.67%</td>
<td>41.67%</td>
<td>12</td>
</tr>
</tbody>
</table>
Q17: How satisfied are you with the

» Answered: 12  Skipped: 4

<table>
<thead>
<tr>
<th></th>
<th>0%</th>
<th>20%</th>
<th>40%</th>
<th>60%</th>
<th>80%</th>
<th>100%</th>
<th>N/A</th>
<th>Total</th>
<th>Weighted Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference field</td>
<td>9.09%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>18.18%</td>
<td>36.36%</td>
<td>36.36%</td>
<td>11</td>
<td>5.73</td>
</tr>
<tr>
<td>measurements</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thematic field</td>
<td>8.33%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>25.00%</td>
<td>25.00%</td>
<td>41.67%</td>
<td>12</td>
<td>5.75</td>
</tr>
<tr>
<td>measurements</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UAV measurements</td>
<td>8.33%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>41.67%</td>
<td>16.67%</td>
<td>33.33%</td>
<td>12</td>
<td>5.50</td>
</tr>
<tr>
<td>measurements</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>2</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>APEX measurements</td>
<td>25.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>16.67%</td>
<td>25.00%</td>
<td>16.67%</td>
<td>16.67%</td>
<td>12</td>
<td>4.33</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Q20: How satisfied are you with the

» Answered: 12    Skipped: 4

<table>
<thead>
<tr>
<th></th>
<th>0%</th>
<th>20%</th>
<th>40%</th>
<th>60%</th>
<th>80%</th>
<th>100%</th>
<th>N/A</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>BELAIR FTP site</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>20.00%</td>
<td>40.00%</td>
<td>20.00%</td>
<td>20.00%</td>
<td>10</td>
</tr>
<tr>
<td>BELAIR Owncloud</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>30.00%</td>
<td>0.00%</td>
<td>70.00%</td>
<td>7</td>
</tr>
<tr>
<td>BELAIR Geoportal</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>45.45%</td>
<td>9.09%</td>
<td>45.45%</td>
<td>11</td>
</tr>
<tr>
<td>BELAIR Website</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>25.00%</td>
<td>41.67%</td>
<td>8.33%</td>
<td>25.00%</td>
<td>12</td>
</tr>
<tr>
<td>BELAIR Newsletter</td>
<td>0.00%</td>
<td>0.00%</td>
<td>8.33%</td>
<td>8.33%</td>
<td>50.00%</td>
<td>8.33%</td>
<td>25.00%</td>
<td>12</td>
</tr>
</tbody>
</table>
Q24 Add all your projects using BELAIR data and add from which BELAIR site

- UrbanEARS (SONIA)
- BELCAM (HESBANIA)
- BelSAR (HESBANIA)
- iPOT (HESBANIA)
- BIO-TIDE (LITORA)
- HYPERTEMP (HESBANIA)
Q25: Did you share your BELAIR data with external users (Belgian or international)? If yes, please specify the user

» Humboldt Universitaet zu Berlin
» ESA, MetaSensing
» Univ. of Notre Dame, Libanon
» Nantes University (BIO-TIDE)
6 PhD, 12 MSc (Nov. 2016)

**BELAIR MSc/PhD**

**HESBANIA**

- **MSc KULeuven**: Yasmin Yenibrabant, "Crop load monitoring in apple orchards through UAVs: a feasibility study", September 2016, promoter Laurent Titis, co-promoter Ben Somers

- **MSc UCL**: Marie Mestdagh, MSc thesis: "Estimation du contenu en chlorophylle chez la pomme de terre par télédétection hyperspectrale aéroportée", September 2016, promoters: Defourny Pierre and Curnel Yannick

- **MSc KULeuven**: Pieters Catheline, "De integratie van drone, vliegtuig- en satellietobservaties voor het opvolgen van fruitboomgaarden", expected June 2017, promoter Ben Somers, co-promotor Laurent Titis

- **PhD ULB**: F. Ben Abdallah, "Etude des potentialités des indices basés sur la concentration en composés phénologiques des feuilles pour l'évaluation du status azoté de la culture de pomme de terre", promoter Jean Pierre Goffart

- **PhD UCL**: Cindy Delloye, "BELCAM", promoter Pierre Defourny

**SONIA**


- **MSc VUB**: Nahad Helmi, "Impact of resolution on urban hydrological response simulation", 2015, promoter: Boud Verbeiren and Ann van Griensven

- **MSc VUB**: Wouter Vermeiren, "Hyperspectral analysis of surface materials for water balance estimation in urbanized areas. A case study on the Brussels Capital Region", September 2015, promoter: Frank Canters, co-promoter: Boud Verbeiren, Department of Geography, Vrije Universiteit Brussel

**LITORA**

- **MSc KULeuven**: Camille Christiansen, "Exploring spectroscopy as a method for the quantification", September 2015, promoter Ben Somers, co-promotor Jeroen Vandenberghe (INBO)

- **MSc KULeuven**: Medart Sam, "Ontwikkelen van een Remote Sensing gebaseerd monitoreningsysteem voor beschermde grasland- en heidegebieden in Vlaanderen", expected June 2017, promoter Ben Somers, co-promotor Stien Heremans (INBO)
Survey feedback and recommendations - for further discussion

» Preparation of campaign
  » Earlier announcement and kick-off of overall campaign for better overall preparation and also involvement of other/new teams
  » Include radar
  » Include thermal observations
  » Expert support for sampling design needed: For the multi-scale validation > how design sampling scheme?
  » UAV: availability of cameras with more bands (hyperspectral?)

» Campaign
  » UAV: Move campaigns to zones with less flight constraints?
  » APEX: Communication (by telephone?) of exact time of overpass for near simultaneous sampling
  » APEX: Feedback from VITO on how good or bad our previous calibration measurements were

» Post-campaign
  » APEX+UAV: Preprocessing of data takes a lot of time
  » Data are available from different sources (ftp, Owncloud, geoportal) (discard FTP ?)
  » Website is rather static. Include also include info on thematic work done on the different sites and scientific output
  » Newsletter looks great, but links should be provided for those looking for more info on work put in focus

- BELAIR: Ils Reusen ([ils.reusen@vito.be](mailto:ils.reusen@vito.be))
- BELAIR HESBANIA: Stephanie Delalieux ([stephanie.delalieux@vito.be](mailto:stephanie.delalieux@vito.be))
- BELAIR LITORA: Liesbeth De Keukelaere ([liesbeth.dekeukelaere@vito.be](mailto:liesbeth.dekeukelaere@vito.be))
- BELAIR SONIA: Boud Verbeiren ([bverbeir@vub.ac.be](mailto:bverbeir@vub.ac.be))
- BELAIR geoportal: Bart Ooms ([bart.ooms@vito.be](mailto:bart.ooms@vito.be))
Thank you