

## BELGIAN AIRBORNE IMAGING SPECTROSCOPY CAMPAIGNS: AN OVERVIEW

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### ABSTRACT

Since 1998 the Flemish Institute for Technological Research (VITO) has been active in airborne imaging spectroscopy (IS). In a joint effort to develop imaging spectroscopy expertise, to foster the use of IS data in Belgian Remote Sensing and to prepare the Belgian research community for the advent of the Swiss-Belgian airborne imaging spectrometer APEX, VITO and the Belgian Science Policy Office organize since 2002, a yearly flight campaign with diverse airborne hyperspectral and imaging spectrometers. From 2006 onwards VITO will be responsible for operating the APEX sensor, from flight planning and data acquisition to processing, archiving and distribution of the data.

### INTRODUCTION

Being convinced of the potential of imaging spectroscopy VITO was involved in the APEX-project (i) (<http://www.apex-esa.org>) since the early stages of the instrument's development. APEX is being built under the authority of the European Space Agency (ESA), with the Remote Sensing Lab (RSL), Zürich, Switzerland, acting as scientific prime institute (PI). From 2006 onwards, VITO will be fully in charge for operating the APEX sensor, from flight planning and data acquisition to processing, archiving and distribution of the data.

In order to prepare for these tasks, VITO, with the support of the Belgian Science Policy Office, has organized since 2002 a yearly "Groupshoot-type" airborne campaign for the Belgian research community. Several airborne imaging spectrometers such as the CASI-2 (Itres), SASI (Itres), Hy-Map (HyVista) and the multispectral ATM sensor (Daedalus) have been deployed.

For the 2004 HyMap-campaign, which was organized in close collaboration with the German Aerospace Center (DLR) Oberpfaffenhofen, Germany, the Belgian researchers were encouraged to establish partnerships with international research institutes and universities. Finally, 9 projects were selected and the flown test sites were spread over the Benelux, Germany and the United Kingdom. In 2005 a new similar hyperspectral flight campaign will be organized with the Airborne Hyperspectral System (AHS) owned by INTA, Spain.

Besides the flight campaign planning and flight operations, VITO is also responsible for the atmospheric correction, archiving and distribution of all data cubes. Those data cubes will become available to the scientific community at large one year after acquisition at nominal costs. The home page of the flight campaigns website <http://campaigns.vgt.vito.be> can be found in Figure 7.

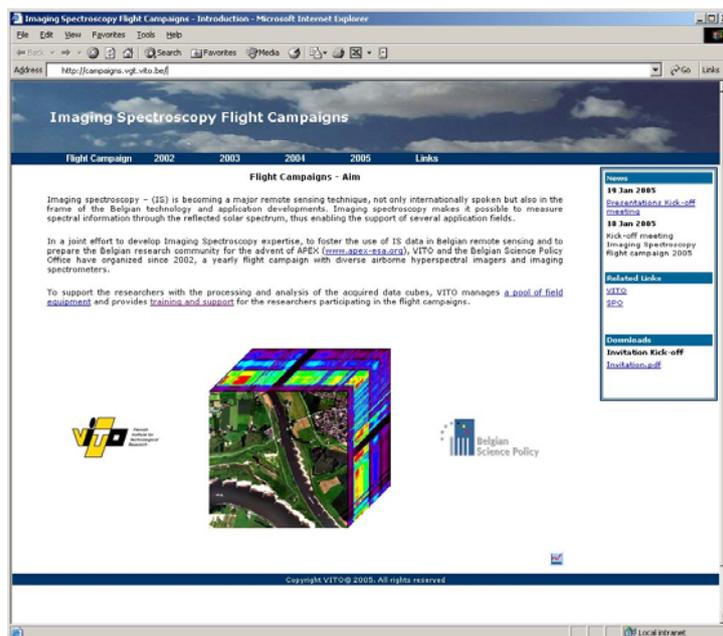


Figure 7: Home page of the flight campaigns website <http://campaigns.vgt.vito.be> where quicklooks of all flight lines can be downloaded.

To support the researchers with the processing and analysis of the data cubes, VITO manages a pool of field equipment (hand-held spectrometers, sunphotometers, GPS,...) (<http://islab.vgt.vito.be>) and provides training and support for the researchers participating in the Groupshoots (<http://hyperteach.vgt.vito.be>).

Research topics are in line with the long-term vision of the Belgian Science Policy Office to establish thematic poles of expertise. Main research themes are:

- Coastal monitoring: estuary biochemistry, optical properties of sediments,
- Environmental monitoring: heavy metal detection, mine waste,
- Vegetation/agriculture: crop monitoring, soil organic matter, ecotype classification,
- Urban studies: spatial information extraction, man-made object classification,

The Belgian Science Policy Office organizes in close collaboration with VITO the yearly Airborne Imaging Spectroscopy workshop where researchers involved in the Groupshoot and others are invited to present their results and to give feedback to the organizers of the Groupshoot.

Besides operational activities, VITO also develops applications (ecosystem monitoring, soil erosion/sedimentation maps, water quality monitoring, ...) based on imaging spectroscopy data. These applications are developed in particular for regional, national and international bodies and authorities (e.g. UNESCO) to support their decision-making process.

## FLIGHT CAMPAIGN 2002

In September 2002, a flight campaign with a **CASI-2** and **SASI** (Itres) onboard a Dornier 228 was organized in collaboration with Itres (CAN). The objective was to collect imaging spectroscopy data of 7 test sites in Belgium of which the geographical location is shown in Figure 8. The applications investigated with CASI-2 and SASI images are listed in Table 1.

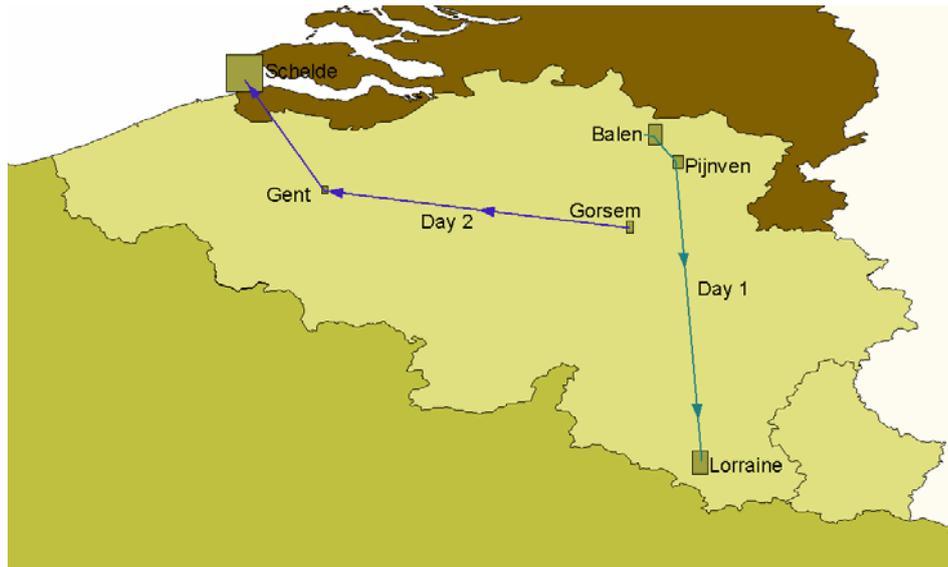


Figure 8: Geographical location of the 7 test sites of the flight campaign 2002.

Table 1: Overview of the applications investigated in flight campaign 2002.

Application field	Topic	Test sites	Teams
Coastal monitoring	Biogeochemistry of Scheldt estuary and plume	Scheldt estuary	RMA ULg, ULB, RUG <a href="mailto:Marc.Acheroy@rma.ac.be">Marc.Acheroy@rma.ac.be</a>
Hydrology	Detection of soil moisture gradients	Dijle Valley	VUB <a href="mailto:batelaan@vub.ac.be">batelaan@vub.ac.be</a>
Forestry	Vitality of perennial plants	Limburg (Pijnven, Gorseme)	KUL <a href="mailto:pol.coppin@agr.kuleuven.ac.be">pol.coppin@agr.kuleuven.ac.be</a>
Pollution monitoring	Detection of heavy metals in plants and solid matrices	Campine (Balen)	VITO LUC <a href="mailto:piet.seuntjens@vito.be">piet.seuntjens@vito.be</a>
Agriculture	Characterisation of permanent grassland canopy	Lorraine	CRAGx <a href="mailto:oger@cra.wallonie.be">oger@cra.wallonie.be</a>
	Estimation of soil organic matter content	Lorraine	FUL <a href="mailto:tychon@ful.ac.be">tychon@ful.ac.be</a>
Urban studies	Spatial information extraction from urban areas	Ghent	RUG VUB, ULg, ULB <a href="mailto:rudi.goossens@rug.ac.be">rudi.goossens@rug.ac.be</a>

### FLIGHT CAMPAIGN 2003

In June and October 2003, a flight campaign with a **CASI-2** and **ATM** sensor onboard a Dornier 228 was organized in collaboration with NERC (UK). Goal was to gather VIS-NIR and thermal images of 7 test sites in Belgium. The geographical location of the test sites is shown in Figure 9, while the applications studied are listed in [Table 2](#).



Figure 9: Geographical location of the 7 test sites of the flight campaign 2003.

Table 2: Overview of the applications investigated in flight campaign 2003.

Application field	Topic	Test sites	Teams
Coastal monitoring	The Yzer estuary	Yzer estuary	KUL RUG, VLM <a href="mailto:jaak.monbaliu@bwk.kuleuven.ac.be">jaak.monbaliu@bwk.kuleuven.ac.be</a>
Geology	Detection of changes induced by active faults	Roer Graben (Bree)	MRAC KMI <a href="mailto:ptrefois@africamuseum.be">ptrefois@africamuseum.be</a>
Soil	Dynamics of soil organic Carbon	Ardennes (Ortho)	UCL <a href="mailto:vanwesemael@geog.ucl.ac.be">vanwesemael@geog.ucl.ac.be</a>
Forestry	Monitoring of stress vegetation and water quality	Sonian Forest	VUB KMI <a href="mailto:pkboekae@etro.vub.ac.be">pkboekae@etro.vub.ac.be</a>
Agriculture	Characterisation of permanent grassland canopy	Lorraine	CRAGx <a href="mailto:oger@cra.wallonie.be">oger@cra.wallonie.be</a>
	Estimation of soil organic matter content	Lorraine	FUL <a href="mailto:tychon@ful.ac.be">tychon@ful.ac.be</a>
Hydrology	Water and energy fluxes in a Riparian wetland	Dijle Valley	VUB <a href="mailto:batelaan@vub.ac.be">batelaan@vub.ac.be</a>

## FLIGHT CAMPAIGN 2004

In May, June and July 2004, a flight campaign with a **HyMap** sensor onboard a Dornier 228 was organized in collaboration with DLR (D). HyMap images of 9 test sites in Belgium, Luxemburg, The Netherlands, Germany and the United Kingdom were collected. International collaboration with experts was encouraged. The geographical location of the test sites are shown in Figure 10, while Table 3 gives an overview of the applications studied with Hymap images.

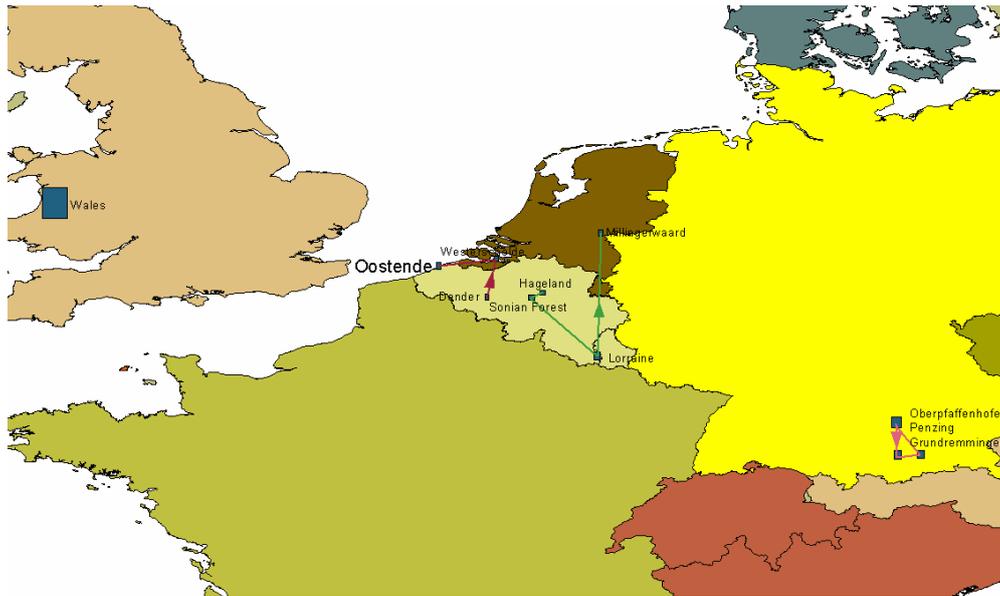


Figure 10: Geographical location of the 9 test sites of the flight campaign 2004.

Table 3: Overview of the applications investigated in the flight campaign 2004.

Application field	Topic	Test sites	Teams
Coastal monitoring and inland waters	Bottom reflectance and adjacency experiment (BRADEX postponed to 2005)	Oostende (B)	MUMM ULCO (F) <a href="mailto:K.Ruddick@mumm.ac.be">K.Ruddick@mumm.ac.be</a>
	Time-dependent changes in the optical properties of sediments (TIDISED)	Westerschelde (NL)	KUL RUG, VITO, NIOO-CEME (NL) <a href="mailto:jaak.monbaliu@bwk.kuleuven.ac.be">jaak.monbaliu@bwk.kuleuven.ac.be</a>
Vegetation-agriculture	Derived nitrogen indicators for maize crop (HYNIM)	Lorraine (B+L)	ULg  UCL, CRP-GL (L) <a href="mailto:tychon@ful.ac.be">tychon@ful.ac.be</a>
	Machine learning techniques for Ecotype classification (ECOMALT)	Dender/Idegem/Moerbeke (B)	IMEC-VUB VLM, Institute of Nature Conservation <a href="mailto:jcheungw@etro.vub.ac.be">jcheungw@etro.vub.ac.be</a>
	Crop productivity - soil erosion relationship (EROCROP)	Hageland/Holsbeek/Lubbeek (B)	KUL BRGM-ARN (F), University of Exeter (UK), Flemish Government <a href="mailto:fleur.visser@geo.kuleuven.ac.be">fleur.visser@geo.kuleuven.ac.be</a>
Methodology	Hyperspectral measurements for the validation of SPOT data products (HYVAL)	Sonian Forest (B)	VUB INRA-CSE (F) <a href="mailto:pkboekae@etro.vub.ac.be">pkboekae@etro.vub.ac.be</a>

	Linking biochemical and biophysical variables derived from IS to ecological models (HYECO)	Millingerwaard (NL)	VUB VITO, WUR-Alterra (NL), ULB, Staatsbosbeheer (NL) <a href="mailto:batelaan@vub.ac.be">batelaan@vub.ac.be</a>
Pollution monitoring	Lead dispersal from abandoned metalliferous mining (WALMET)	Rheidol Valley , Wales (UK)	MRAC BGS (UK) <a href="mailto:ptrefois@africamuseum.be">ptrefois@africamuseum.be</a>
Urban studies	Man-made object classification using fused polarimetric SAR and hyperspectral data (HYSAR)	Penzing, Grundremmingen Oberpfaffenhofen (D)	RMA VITO, DLR (D) <a href="mailto:Marc.Acheroy@rma.ac.be">Marc.Acheroy@rma.ac.be</a>

### FLIGHT CAMPAIGN 2005

In June 2005, a flight campaign with an **Airborne Hyperspectral System (AHS)** onboard a CASA 212-200 will be organized in collaboration with INTA (ESP). AHS images (VIS-NIR, SWIR, MIR, TIR) from 6 test sites in Belgian, The Netherlands and Spain will be collected. Information about the AHS sensor can be found at <http://www.crepad.rcanaria.es>.

### CONCLUSIONS

Imaging spectroscopy is becoming a major remote sensing technique, not only internationally but also for the Belgian technology and application developers. Thanks to the availability of imaging spectroscopy data in Belgium the Belgian imaging spectroscopy community is expanding rapidly. The usefulness of imaging spectroscopy data in several scientific disciplines was investigated and the road for the development of operational services was paved. To stimulate the use of imaging spectroscopy data in Belgium and abroad the data cubes collected during the flight campaigns will become available to the scientific community at large at nominal costs one year after data acquisition. For further information, please visit <http://campaigns.vgt.vito.be>.

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### References

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