

Report of the AGRICAB/E-AGRI Hands-on training on image classification using high resolution satellite imagery over Kenya

Nairobi, Kenya, 25-29 November 2013

Date 25-29 November 2013
Location DRSRS, Nairobi, Kenya
Topic **AGRICAB/E-AGRI Hands-on training on image classification using high resolution satellite imagery over Kenya**
Participants See list below
Diffusion All E-AGRI/AGRICAB partners

Version	Prepared by	Date
1.0	Roel Van Hoolst (VITO)	04-12-2013

Acronyms

VITO	<i>Vlaamse Instelling voor Technologisch Onderzoek</i> (Flemish Institute for Technological Research)
DRSRS	Department of Resource Surveys and Remote Sensing
FAO	Food and agricultural organization of the United Nations
KMD	Kenya Meteorological Department
RCMRD	Regional Center for Mapping and Resources for Development
JKUAT	Jomo Kenyatta University of Agriculture and Technology
ROI	Region of interest

1 INTRODUCTION

From Monday 25 November – Friday 29 November 2013 a training was planned at the ‘Department of Resource Surveys and Remote Sensing’ (DRSRS) in Nairobi, Kenya. This workshop fitted within the E-AGRI and AGRICAB projects and focused on the classification of high resolution satellite imagery and ground survey data to generate land cover maps over a ROI in Kenya. The derived land cover maps will be used in further stages to improve crop acreage estimations.

The training was planned to be a ‘hands-on training’ for a group of about 15-20 people, namely the people involved in the generation of crop acreage statistics at DRSRS, operational crop monitoring (FAO, RCMRD), research oriented use cases (JKUAT) and interdisciplinary knowledge sharing (KMD).

This workshop focused on a case study on the use of remote sensing technology for crop specific mapping in the Kakamega and Butere province in Kenya (see figure 1). During the 2013 long rains crop season, single date high resolution RapidEye, three Deimos-1 and five Landsat8 images were acquired between April-July/2013. Moreover, an extensive field and aerial survey was performed (June-July/2013) in order to generate crop area statistics and ground truth data for image interpretation.

The acquired data was used in the workshop in hand on exercises on image classification using three different software packages: ENVI, QuantumGIS and GRASS.

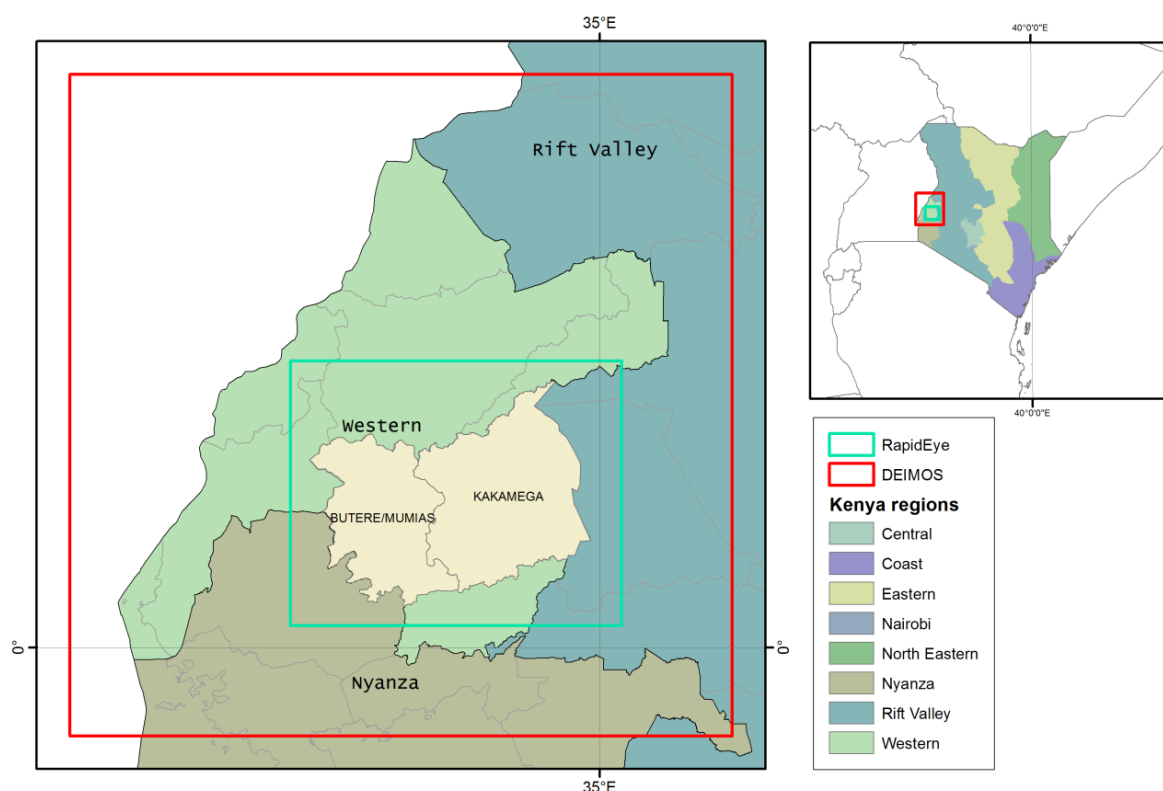


Figure 1: The study area of the workshop is located in Western Kenya. Data acquired over the Kakamega province was used in the exercises.

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2 PARTICIPANTS

Nb	Name	Organization	e-mail	Mon	Tue	Wed	Thu	Fri
1	Abdi Gedi Ali	RCMRD	dmacharia@rcmr.org	X	X	X	X	X
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4	Alex Koton	FAO	Alex.koton@fao.org	X	X	X	X	X
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21	Simon Kimath Nyaga	DRSRS	kimathsimons@gmail.com			X	X	X
21	Purity Wanjiru	DRSRS (support)		X	X	X	X	X
22	Pamela W. Njiru	DRSRS (support)		X	X	X	X	X
23	Etiud Nalimbe	DRSRS (support)		x	x		X	X
23	Michele Downie	ITA	studiomappe@gmail.com	x	X	X	X	X
24	Roel Van Hoolst	VITO	roel.vanhoolst@vito.be	x	X	X	X	X

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3 AGENDA

WORKSHOP PROGRAM

DAY/DATE	SESSION	ACTIVITY	VENUE	TRAINER/PRESENTER
MONDAY 25/11/2013	MORNING	- Registration of participants - Self-introduction - Opening remarks by Director,DRSRS - General introduction of E-AGRI/ AGRICAB Projects	Main conference room	Mr.Roel Vanhoolst (VITO) Mr.Michele Downie (ITA)
	AFTERNOON	- Installation of software - Exercise_1		Mr.Roel Vanhoolst (VITO) Mr.Michele Downie (ITA)
TUESDAY 26/11/2013	MORNING	- Introduction on Remote Sensing for Land cover mapping(sensors, pre-processing & classification algorithms) - Exercise_2		Mr.Roel Vanhoolst (VITO)
	AFTERNOON	- Continuation of exercise_2 on ENVI		Mr.Roel Vanhoolst (VITO)
WEDNESDAY 27/11/2013	MORNING	- Rapid eye image processing & classification. a) Use of Rapid eye image in AGRICAB user case study in Kenya(Kakamega &Butere regions) b) Advantages & applications - Developing methodology		Mr.Michele Downie (ITA)
	AFTERNOON	- Exercise_3: GRASS introduction		Mr. Michele Downie (ITA) Mr.Roel Vanhoolst (VITO)
THURSDAY 28/11/2013	MORNING	- Land cover mapping, results of Chinese Academy of Agricultural sciences(CAAS) - Exercise:Landsat_8 processing & classification		Mr.Roel Vanhoolst (VITO) Mr.Michele Downie(ITA)
	AFTERNOON	- GRASS Exercise - QGIS Exercise		Mr.Roel Vanhoolst (VITO) Mr.Michele Downie (ITA)

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FRIDAY 29/11/2013	MORNING	- Feedback - Presentation of training certificates - Closure.	Main conference room	All Mr. Charles Situma, Roel, Michelle
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4 REPORT OF THE HANDS-ON TRAINING

VITO (Roel Van Hoolst) and ITA (Michele Downie) were accommodated in the Hanan Guest House, at about 1 km (5-10 minute drive) from DRSRS.

Michele Downie, consultant at ITA, was already one week before at DRSRS. He supported DRSRS in the ground survey in June-July/2013. During his stay at DRSRS his main task was to work with the acquired data and develop a RapidEye classification methodology. He spent his time the first week on giving dedicated training to a small number of DRSRS staff. On Sunday 24th Michele and Roel discussed and refined the workshop program together with Vincent Imala from DRSRS.

The official workshop started on Monday 25/11/2013 with an opening session. Mr. Charles Situma, SAD at DRSRS, welcomed the trainees and trainers and gave a brief introduction to AGRICAB and E-AGRI and previous work done within these projects and the objective of the current workshop. After the opening of the workshop, the trainers and participants presented themselves.

Roel Van Hoolst gave an introductory presentation on E-AGRI/AGRICAB and how the workshop fits within these projects. This introduction was followed by a general presentation on land cover mapping with satellite data. A focus was made on defining land cover categories. Here the LCCS software of FAO was introduced. After an explanation the software was installed at each trainees PC and a collective exploration of LCCS was done. After lunch a presentation was given by Roel Van Hoolst on basic remote sensing concepts: a brief recapitulation of the necessary theory for working with satellite data. After this the ENVI software was installed at the trainees PC. A temporal license key was available. Once installed a first exercise was given as an introduction to ENVI and to grasp the remote sensing concepts by hands on experience. Using dedicated tutorials each trainee could work at his/her own pace.

On Tuesday morning a presentation was given by Roel Van Hoolst on remote sensing concepts for image classification. Here, the theoretical details were explained that form the base for classification of satellite imagery. Following this presentation, a hands on exercise was done by the trainees. The exercises objective was to explore the remote sensing concepts for image classification. E.g. spectral profile, display 2D feature space, define ROI's, unsupervised and supervised classification, post classification, and validation. All these modules were applied on Landsat imagery over the Kakamega province and data collected at the field survey of DRSRS. Some results of the exercises are shown in ANNEX I.

On Wednesday Michel Downie presented step by step the work he had done together with DRSRS in the previous week. Consecutively an introduction to the GRASS software was given by Michele. A special focus was made on the set up of a GRASS project and explaining the GRASS structure, the most difficult parts for most users. A number of modules (e.g. import raster, define region, color image,...) were collectively tested.

CAAS (Chinese Academy of Agricultural Sciences), a partner within the E-AGRI project, was initially invited but had problems with the acquisition of their visa. CAAS did an extensive work within the E-AGRI project on crop classification over Kenya using limited ground truth data. Roel Van Hoolst presented on Thursday morning the work of CAAS on their behalf. Together with the local experts (i.e.

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the Kenyan trainees) the methodology and results of this ambitious work was discussed. Afterwards the ENVI exercises were completed and an exercise in QuantumGIS, using the interesting plugin OpenLayers, was given.

On Friday, the participants discussed in detail the ground survey approach based on their experiences. Next, a feedback conversation was done on the image classification workshop. In general, the participants were very satisfied except for some remarks on the duration (too short) and software (ENVI is not free; 3 softwares can be too much within one week). A detailed analysis of the feedback is given below. After the discussions, Charles Situma and the Director of DRSRS gave a closing word. Finally, certificates of attendance were given by the Director and the trainees to all participants. Around 2 pm the workshop was closed. Some pictures of the workshop are shown in ANNEX II.

5 EVALUATION

A standard training evaluation form was used for the evaluation of the workshop. In general, the workshop was evaluated positively. One major drawback was the duration of the training, which was too short according to the trainees to get acquainted with all the three softwares. A suggestion was to focus on one software. Also, one suggested giving extra exercises as “homework” to maintain and improve the gained expertise. Alex Koton of FAO suggested including a knowledge sharing session between the invited institutes, i.e. presenting and comparing different methodologies for crop monitoring etc. He also commented to give more attention to the data acquisition. But in general participants were very enthusiastic, especially about the hands on exercises, and the workshop was well appreciated.

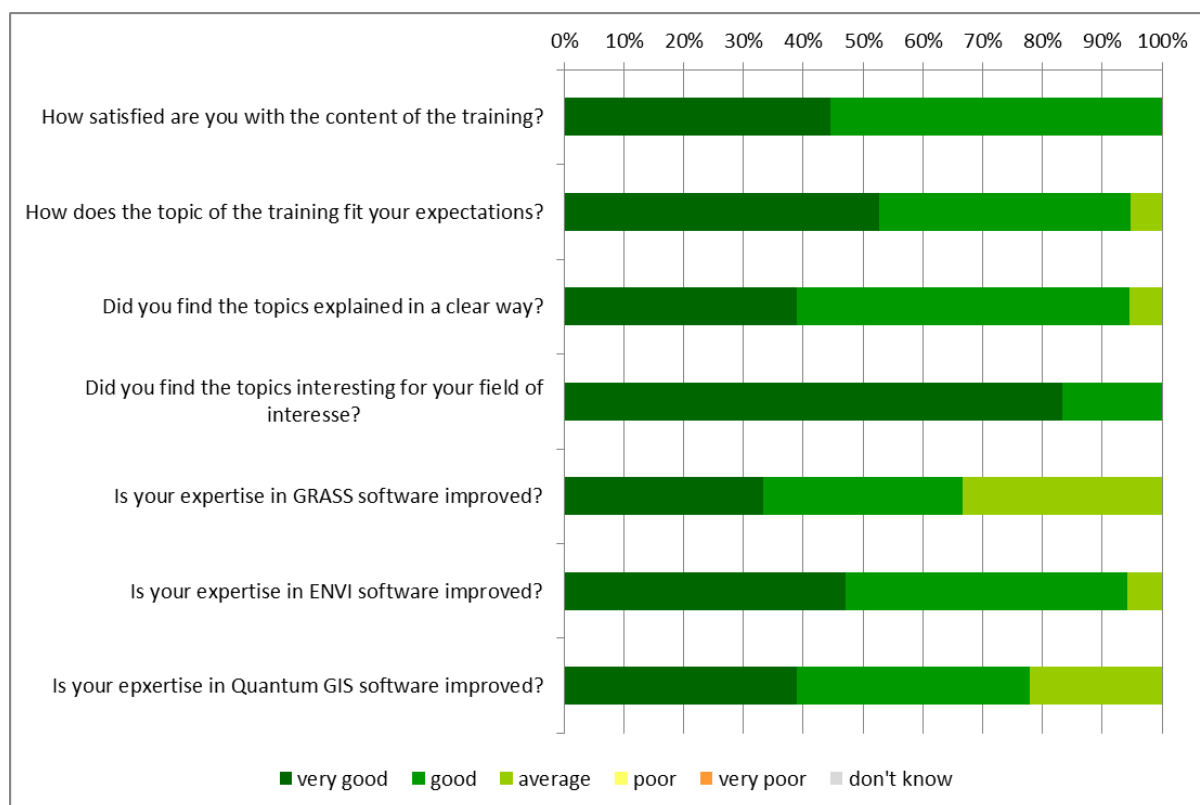
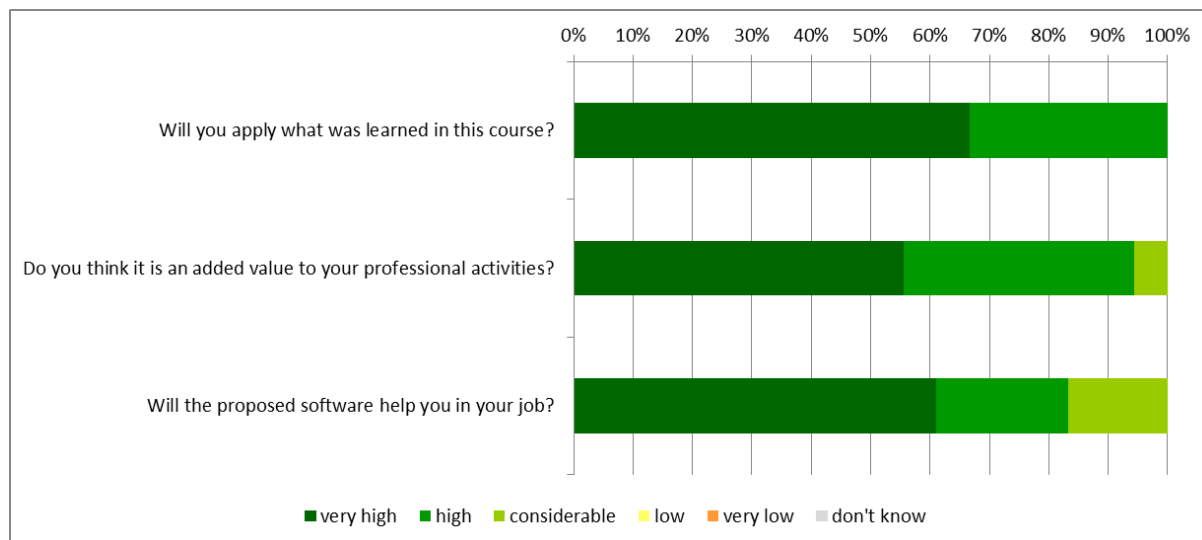


Figure 2 Evaluation of the workshop



ANNEX I: DATA AND RESULTS OF THE CLASSIFICATION EXERCISES IN ENVI

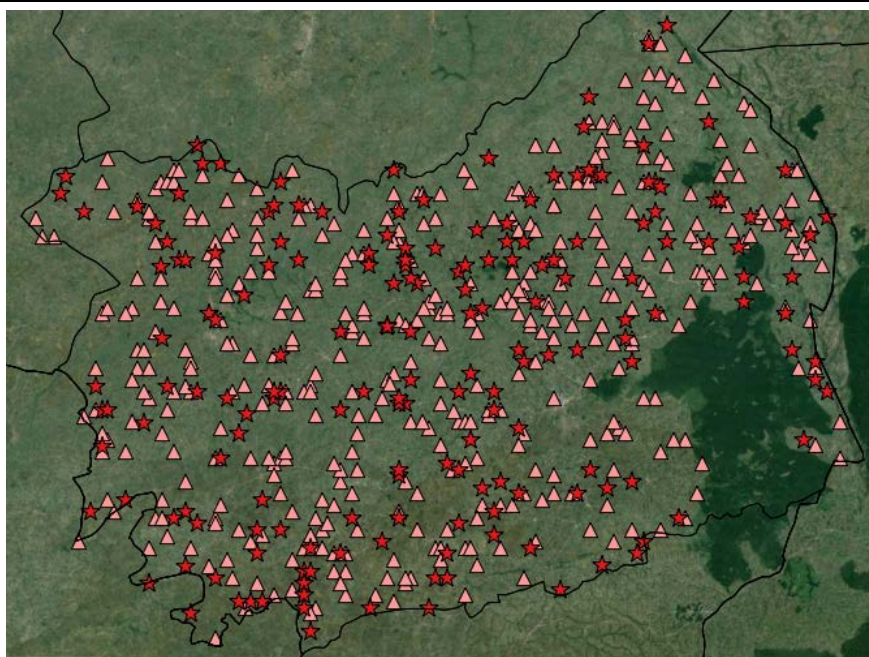


Figure 1: Point sample collected during the ground survey in June-July/2013. These data was used as reference data in the classification exercises. Processed by Michele Downie, Consorzio ITA.

Preprocessed DEIMOS and Landsat8

Although the time window for DEIMOS acquisitions coincided with the rainy season and thus chances for low cloud cover at the time of satellite overpass were relatively low, 3 relatively cloud free images could be acquired. The dataset is complemented with 5 Landsat8 images freely available through USGS-EarthExplorer. The images were preprocessed, including radiometric and atmospheric corrections, spatial sub setting, resampling to 25m resolution and cloud cover removal.

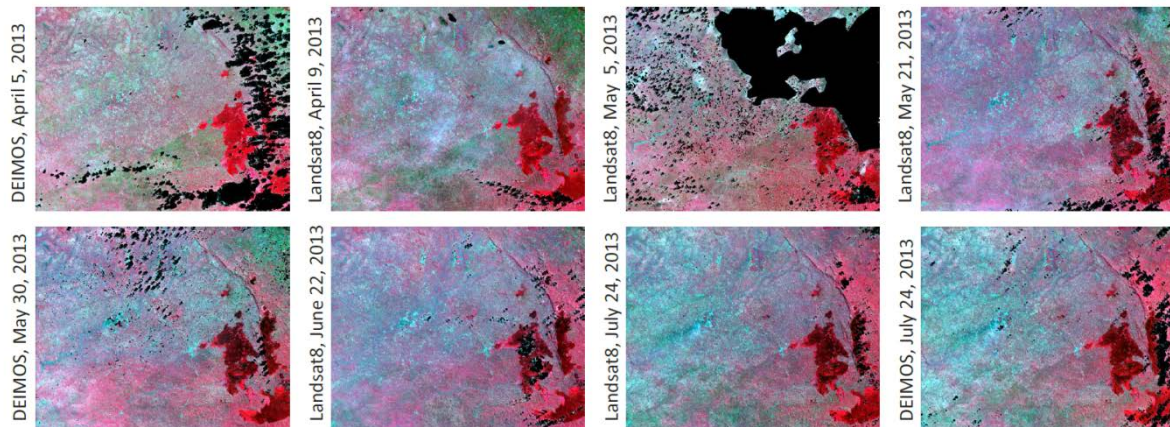


Figure 2: Overview on the acquired and preprocessed DEIMOS and Landsat8 data. The workshop focused on the classification the Landsat8, May 21, 2013 image (right top). Reference: Carolien Tote et al. Monitoring Agricultural Drought with Remote Sensing Data: Combining high resolution and multi-temporal remote sensing data for crop mapping in Africa, AfricaGIS 2013 & GDSI 14 Addis, Ethiopia, 04-08/11/2013

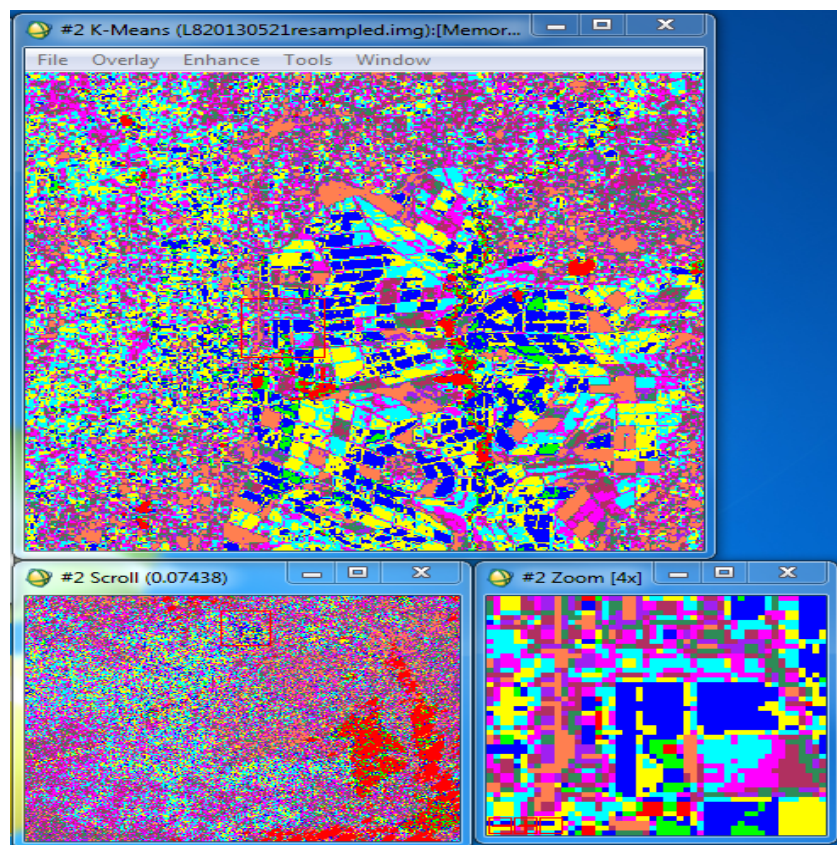


Figure 3: Result of the K-means classifier over the Kakamega province as displayed by the ENVI software.

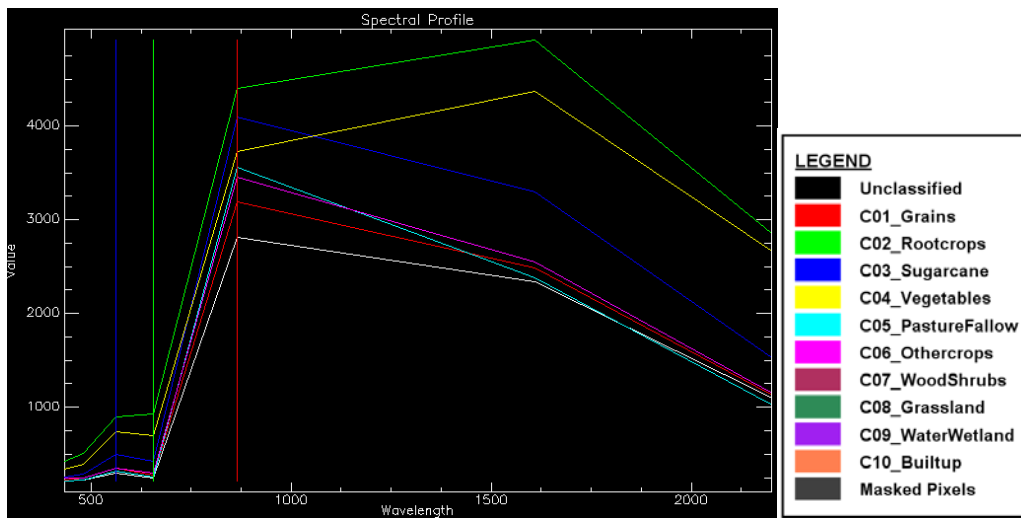


Figure 4: Analysis of the spectral profiles of the different training classes as displayed by the ENVI software.

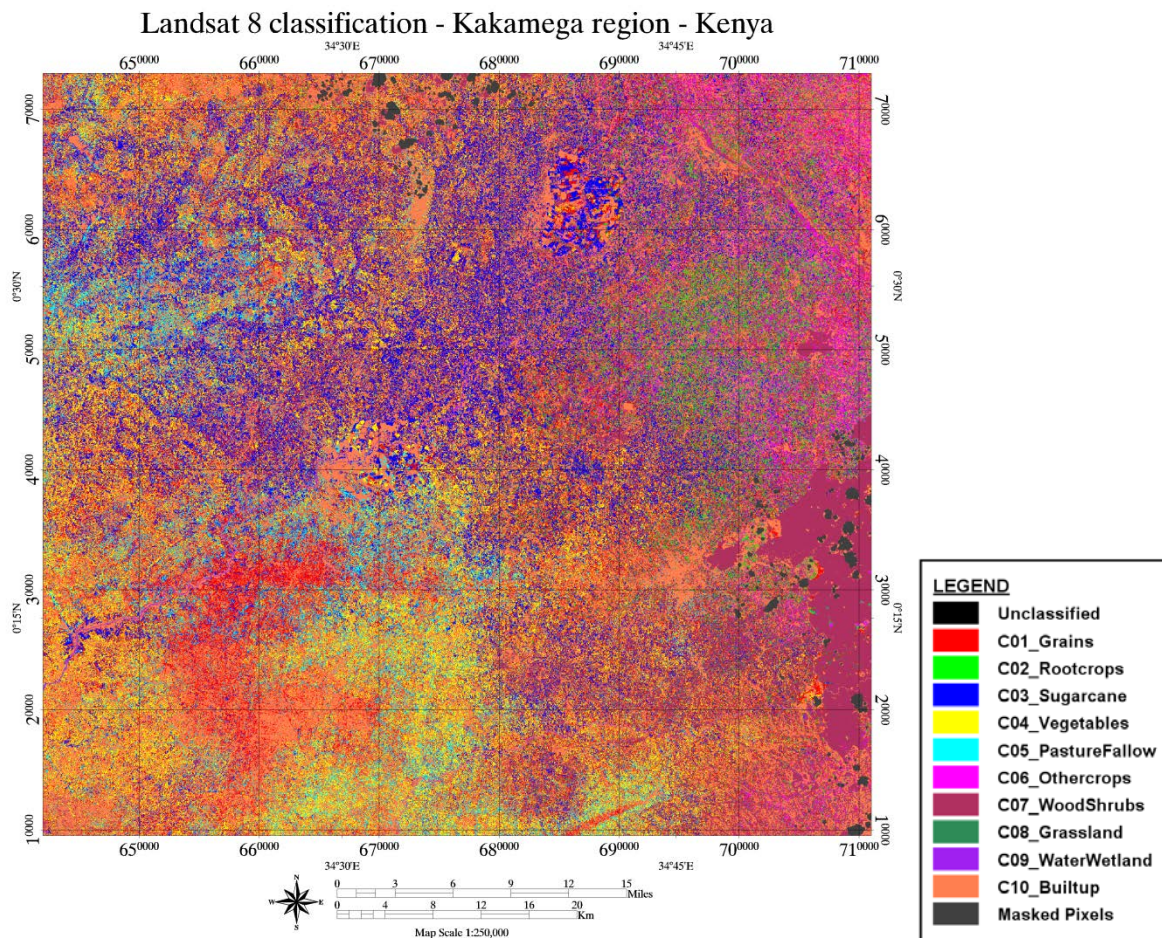


Figure 5: Result of the Maximum Likelihood classifier over the Kakamega province using ground truth dataset as training data.

Ground truth

Class	V01_Grains	V02_Rootcrop	V03_Sugarcane	V04_Vegeta	V05_PastureFa	V06_Othercrop	V07_WoodShru	V08_Grassland	V09_WaterWet	V10_Buildup	Total
C01_Grains	107	10	92	0	2	3	0	10	0	1	225
C02_Rootcrops	0	0	7	0	0	0	0	16	0	1	24
C03_Sugarcane	40	3	223	0	0	6	2	24	0	0	298
C04_Vegetable	22	0	19	0	18	0	1	1	0	2	63
C05_PastureFa	63	0	29	0	0	0	0	0	0	0	92
C06_Othercrop	8	0	0	0	0	0	0	0	0	0	8
C07_WoodShru	7	0	24	0	1	1	83	0	0	2	118
C08_Grassland	6	1	19	0	0	1	1	9	0	1	38
C09_WaterWet	0	0	0	0	0	0	0	0	18	0	18
C10_Buildup	79	8	96	4	4	9	5	14	2	18	239
Total	332	22	509	4	25	20	92	74	20	25	1123

Figure 6: Result of the validation of the Maximum Likelihood classification (figure 5) over the Kakamega province using ground truth dataset as validation data.

ANNEX II: PICTURES OF WORKSHOP ACTIVITIES



