Koumbia – Burkina Faso

JECAM/GEOGLAM Science Meeting

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AGHRYMET

Site Description

🇧🇫 Location: Burkina Faso

🇧🇫 Topography: flat

🇧🇫 Soils : Mostly sandy

🇧🇫 Drainage class/irrigation: No

🇧🇫 Crop calendar: June to Oct

🇧🇫 Field size: ≤ 3ha

🇧🇫 Climate and weather: Tropical dry

🇧🇫 Agricultural methods used: rainfed crops

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maize

cotton

sorghum

rice

Project Objectives

- Crop identification and Crop Area Estimation
  - Based on a combination of :
    - VHSR image with optical HSR time series
    - Optical + SAR data time series

- Cropping system characterization
  - Crop rotation
  - Fallow mapping ????

- Yield Prediction and Forecasting
  - Statistical approach
  - SARRA-H modeling

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2015 Earth Observation Data Used

Pléiades

- Airbus DS

- Optical (1200 km²)

- Nber of scenes: 3

- Cloud-free acquisition
  challenge, cost

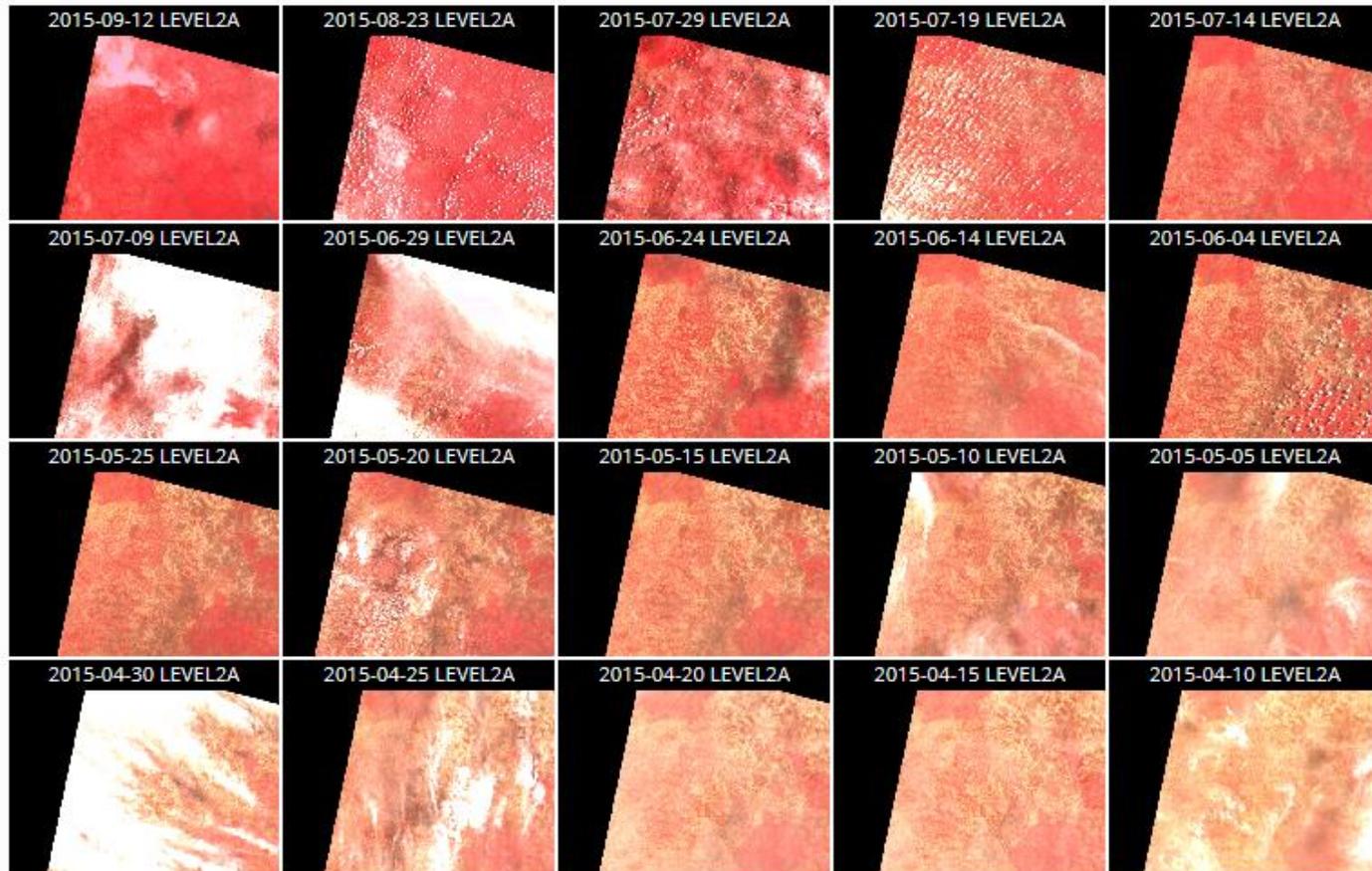- 4 years : 2012, 2013, 2014 and
  2015 (generally sept-nov)

Koumbia

0   5   10 Km
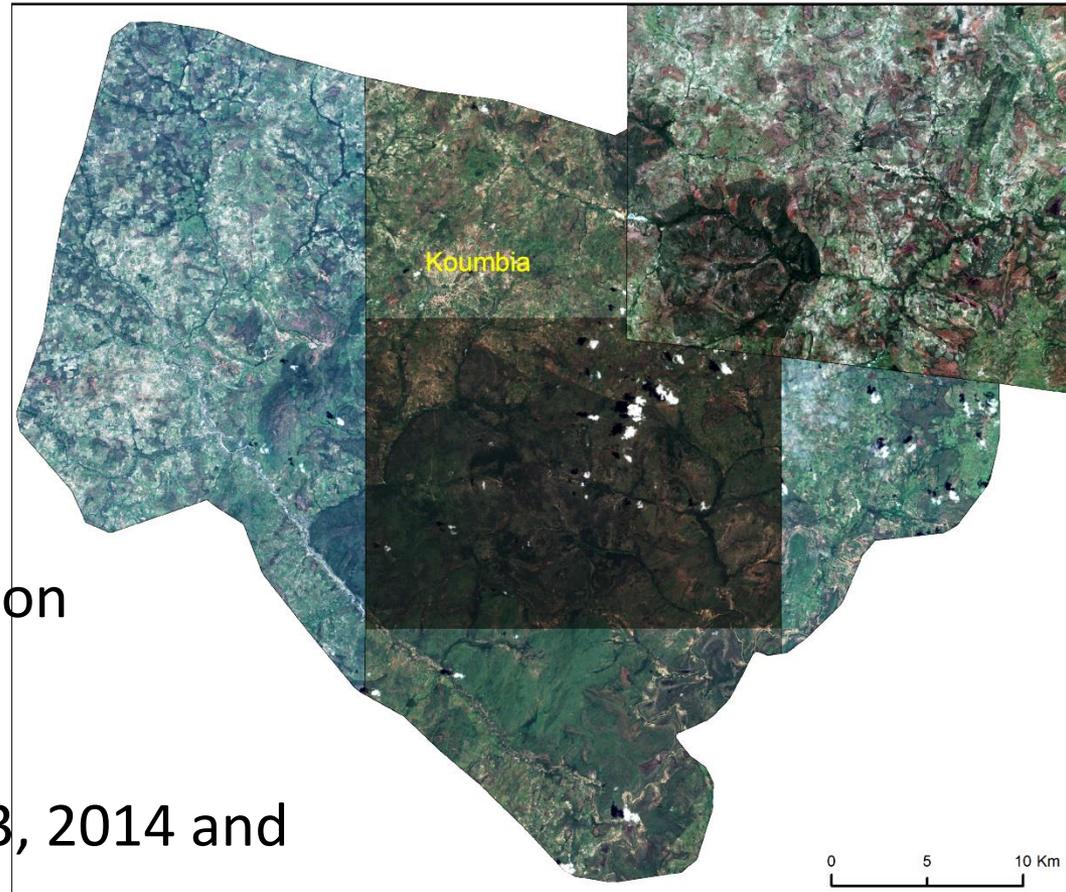
2015 Earth Observation Data Used

SPOT6

- Airbus DS

- Optical (~5000 km²)

- Nber of scenes: 2

- Cloud-free acquisition

  challenge, cost

- 2015 (11 sept – 9 oct)

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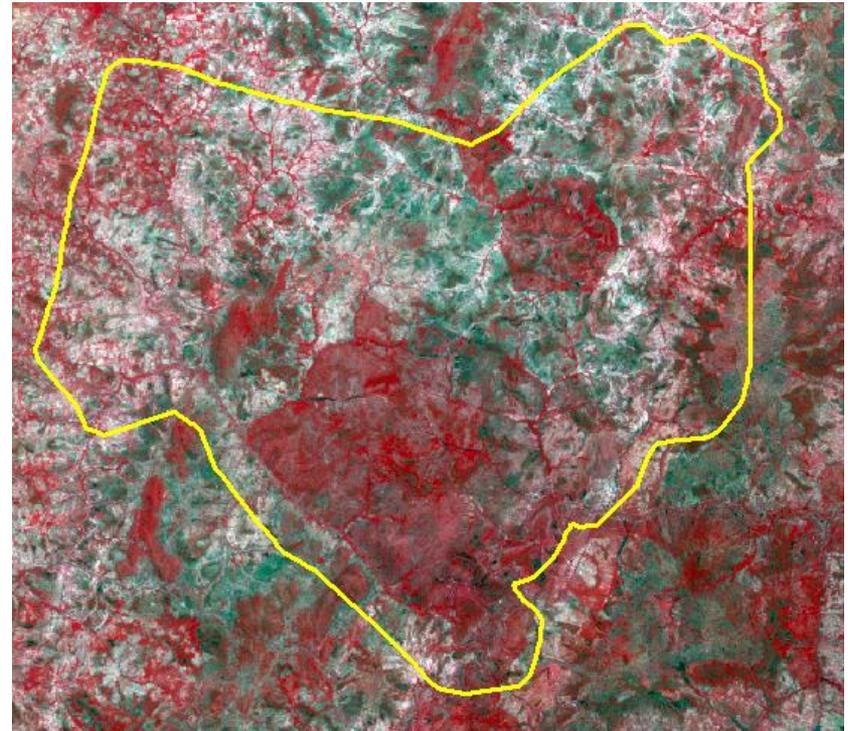**GEO** GROUP ON EARTH OBSERVATIONS

2015 Earth Observation Data Used

SPOT5/TAKE5 (April-mid September)

2015 Earth Observation Data Used

Landsat 8

- USGS

- Optical

- Nber of scenes: ?

- Clouds ....

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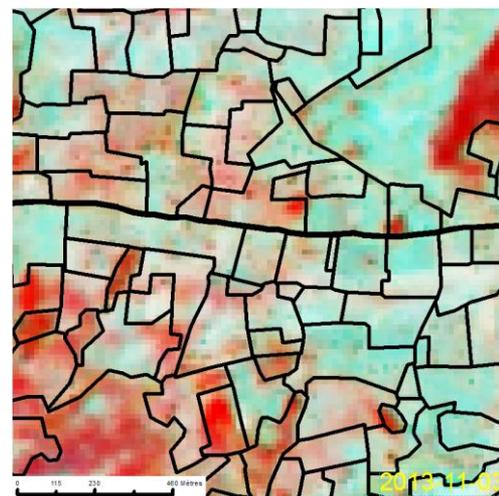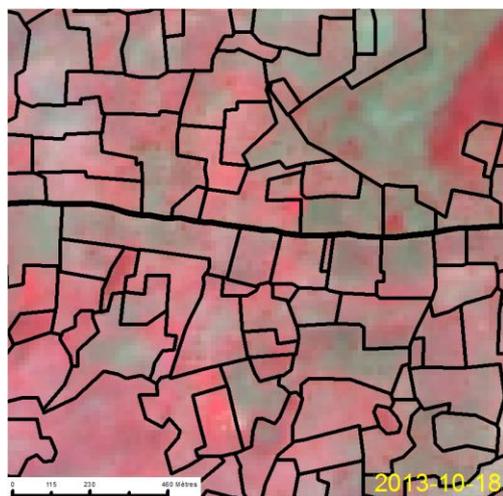
2015 Earth Observation Data Used

RADARSAT

- SAR

- Nber of scenes: ~20

- 20 m resolution

+ SENTINEL-1 ????

1	2015-May-02 18	ASC	Right	FQ (FQ5)	H+V	H+V
2	2015-May-25 06	DES	Right	FQ (FQ9)	H+V	H+V
3	2015-May-26 18	ASC	Right	FQ (FQ5)	H+V	H+V
4	2015-Jun-18 06:	DES	Right	FQ (FQ9)	H+V	H+V
5	2015-Jun-19 18:	ASC	Right	FQ (FQ5)	H+V	H+V
6	2015-Jul-12 06:0	DES	Right	FQ (FQ9)	H+V	H+V
7	2015-Jul-13 18:2	ASC	Right	FQ (FQ5)	H+V	H+V
8	2015-Aug-05 06	DES	Right	FQ (FQ9)	H+V	H+V
9	2015-Aug-06 18	ASC	Right	FQ (FQ5)	H+V	H+V
10	2015-Aug-29 06	DES	Right	FQ (FQ9)	H+V	H+V
11	2015-Aug-30 18	ASC	Right	FQ (FQ5)	H+V	H+V
12	2015-Sep-22 06:	DES	Right	FQ (FQ9)	H+V	H+V
13	2015-Sep-23 18:	ASC	Right	FQ (FQ5)	H+V	H+V
14	2015-Oct-16 06:	DES	Right	FQ (FQ9)	H+V	H+V
15	2015-Oct-17 18:	ASC	Right	FQ (FQ5)	H+V	H+V
16	2015-Nov-09 06	DES	Right	FQ (FQ9)	H+V	H+V
17	2015-Nov-10 18	ASC	Right	FQ (FQ5)	H+V	H+V
18	2015-Dec-03 06:	DES	Right	FQ (FQ9)	H+V	H+V
19	2015-Dec-04 18:	ASC	Right	FQ (FQ5)	H+V	H+V
20	2015-Dec-27 06:	DES	Right	FQ (FQ9)	H+V	H+V
21	2015-Dec-28 18:	ASC	Right	FQ (FQ5)	H+V	H+V

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In situ Data

Field surveys in 2012, 2013, 2014 and 2015 :

- 700 GPS points (about the same then in 2014) -> 700 digitized fields

Mission terrain
Site de Koumbia

Parcelles visitées

En fond :
Image Pléiades du 11/09/2015
(proche infrarouge, rouge, vert)

0   2   4   Kilomètres

© Airbus DS, Distribution GEO SUD
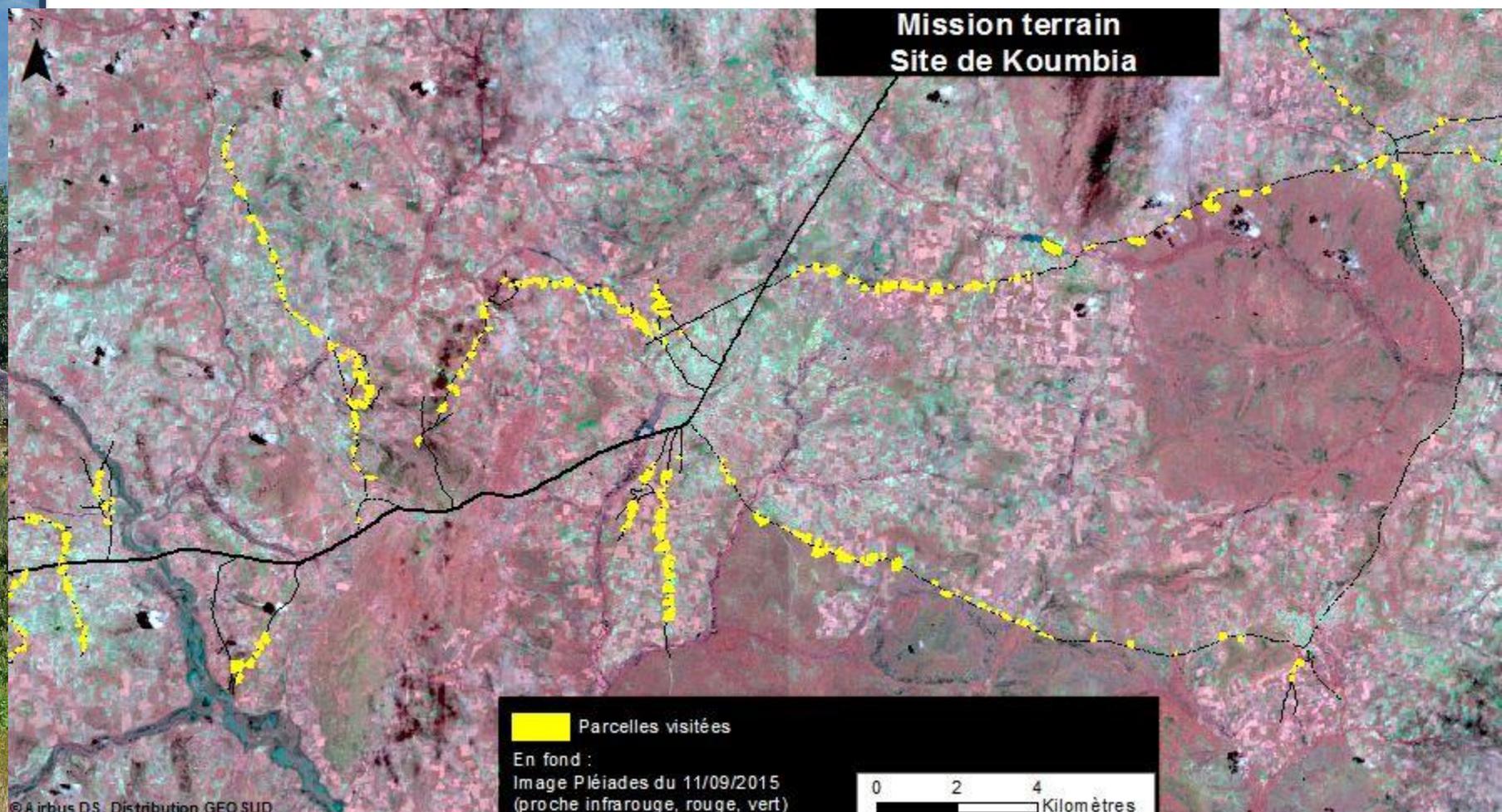
In situ Data

🏞 Yields measurements over a surface of 3900 km²

– 2014 and 2015 cropping seasons

– 6 villages with 30 fields by villages (180 fields)

– 3 rain gauges by villages
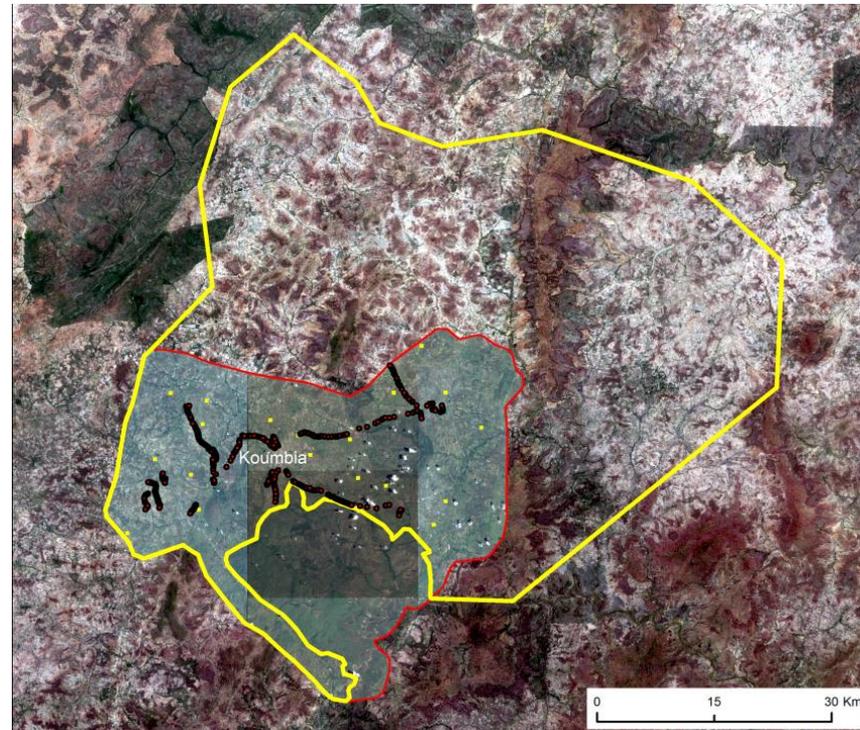
Collaboration

- Collaboration with other CIRAD JECAM sites
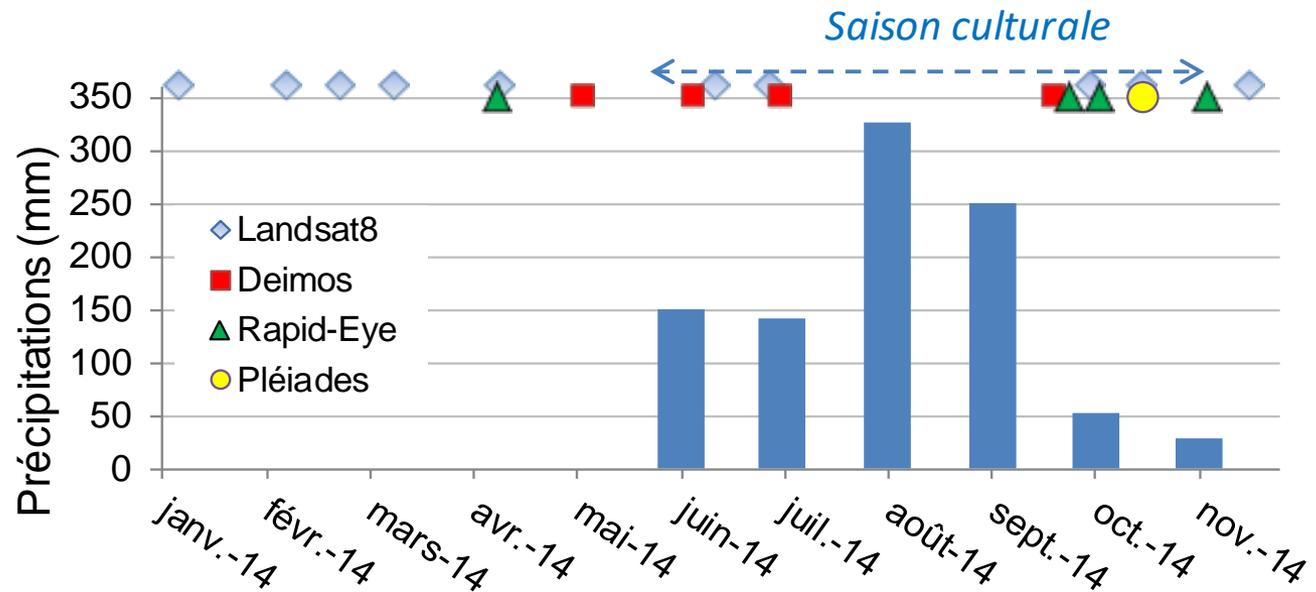 Madagascar
- SIGMA European Collaborative Project
- African partners:
  - Burkina : Bobo Dioulasso University, CIRDES (yield part)
  - Niger : AGRHYMET (early warning system)

2014 Method & results

VHSR image + HSR optical time series

Saison culturale

Précipitations (mm) — Landsat8, Deimos, Rapid-Eye, Pléiades

janv.-14, févr.-14, mars-14, avr.-14, mai-14, juin-14, juil.-14, août-14, sept.-14, oct.-14, nov.-14

2014 Method & results

- VHSR image + HSR optical time series
- Learning data base : 700 fields * 242 variables
- Random Forest

	Landsat 8	Deimos	RapidEye	Pléiades	SRTM	TOTAL
Spectral indices	BRI ->11 EVI->11 IVE->22 NDVI->22 NDWI->22	BRI ->3 IVE->6 NDVI->6	BRI ->4 EVI->4 IVE->8 NDVI->8	BRI ->1 EVI->1 IVE->2 NDVI->2	-	133
VIS refl.	89	-	-	6	-	95
PAN refl.	-	-	-	2	-	2
Texture	-	-	-	8	-	8
Other variables					DEM->2 SLOPE->2	4
TOTAL	177	15	24	22	4	**242**

2014 Method & results

JECAM nomenclature + Level 0

Level 0	Level A	Level B	Level C	Level D
Non-crop	Water bodies	Water bodies	Water bodies	Water bodies
	Build-up surface	Build-up surface	Build-up surface	Build-up surface
	Natural spaces	Rocs	Rocs	Rocs
		Grassland	Herbaceous savannah	Herbaceous savannah
		Natural forest	Natural forest	Natural forest
		Shrub land	Savannah with shrubs	Savannah with shrubs
	Fallow	Young fallow	Young fallow	Young fallow
		Old fallow	Old fallow	Old fallow
Crop	Ligneous crop	Other Cash woody crops	Other Cash woodycrops	Other Cash woodycrops
	Annual cropland	Oilseed	Groundnuts	Groundnuts
			Other	Sesame
			Soybean	Soybean
		Leguminous	Cowpeas	Cowpeas
		Cash crop	Fibre crop	Coton
		Cereals	Maize	Maïze
			Millet	Millet
			Rice	Rice
			Sorghum	Sorghum
Cropland	**Land cover**	**Crop group**	**Crop class**	**Crop sub-class**

2014 Results

Classification results (RF OOB error)

Overall accuracy
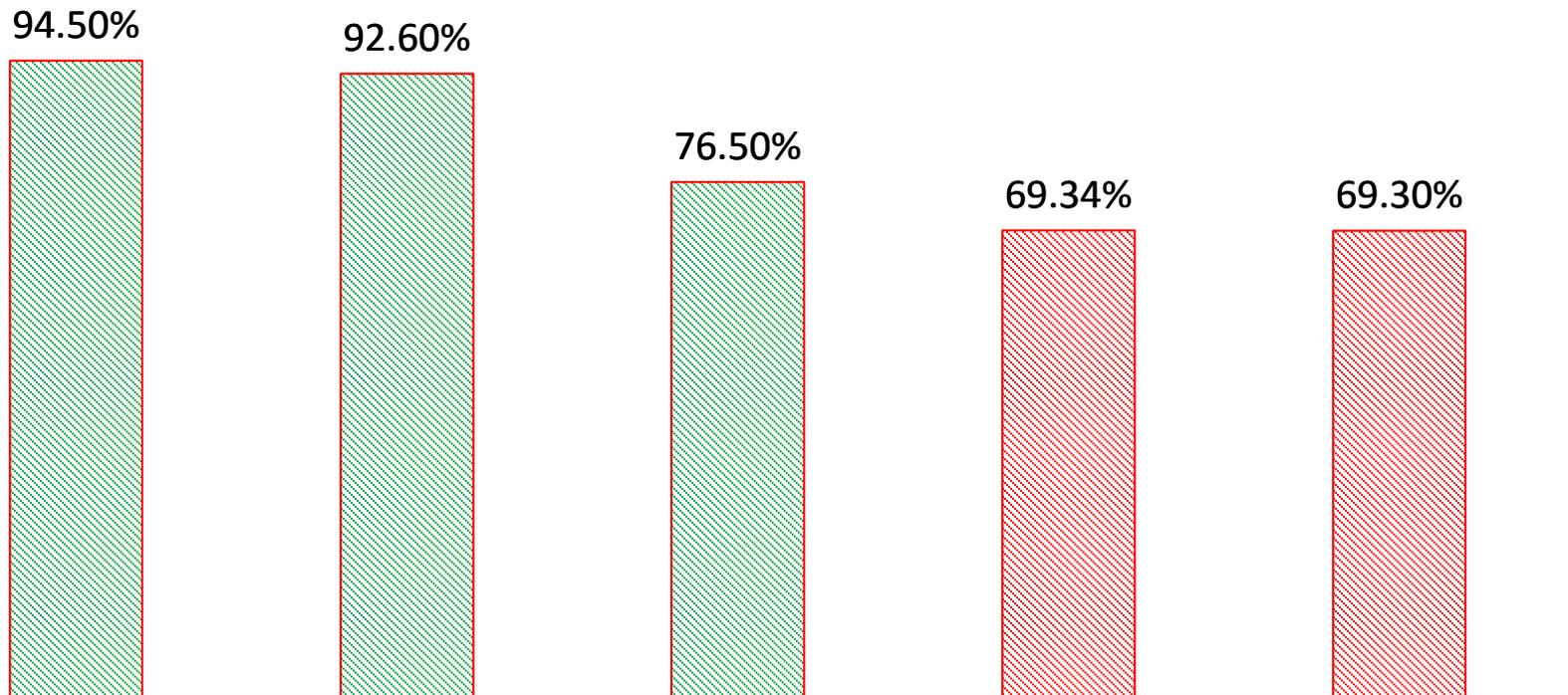
94.50%	92.60%	76.50%	69.34%	69.30%
LEVEL 0	LEVEL A	LEVEL B	LEVEL C	LEVEL D
Cropland	Land cover	Crop group	Crop class	Crop sub-class

2014 Results

Classification strategy experiments

Overall accuracy (crop groups; Level B)

52.6% 45.5% 47.5%

Hierarchical Regrouping Traditionnal

1. Crop/non crop classification
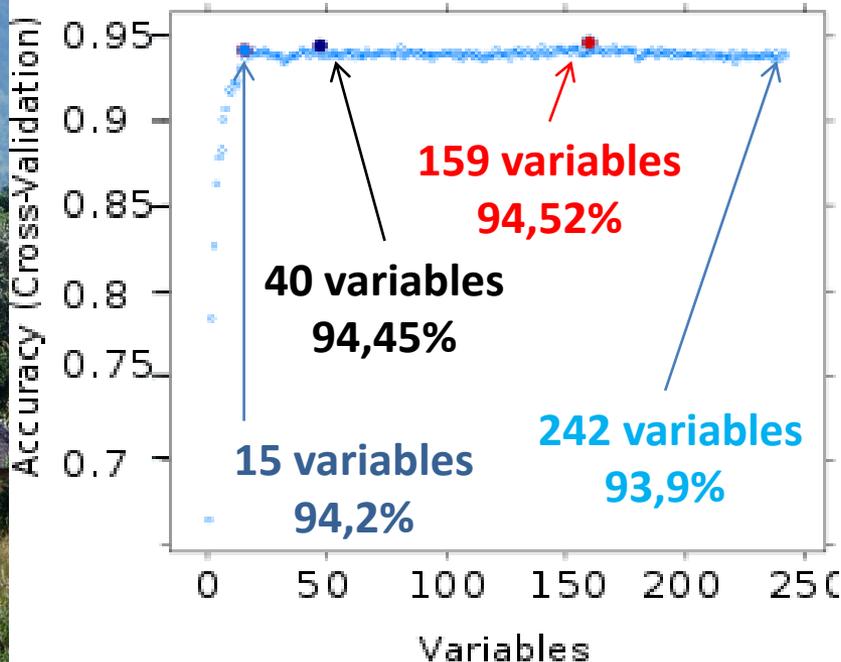2. « Crop group » and « crop class » classification within the cropland only

1. Level D classification
2. Lower levels maps by regrouping classes

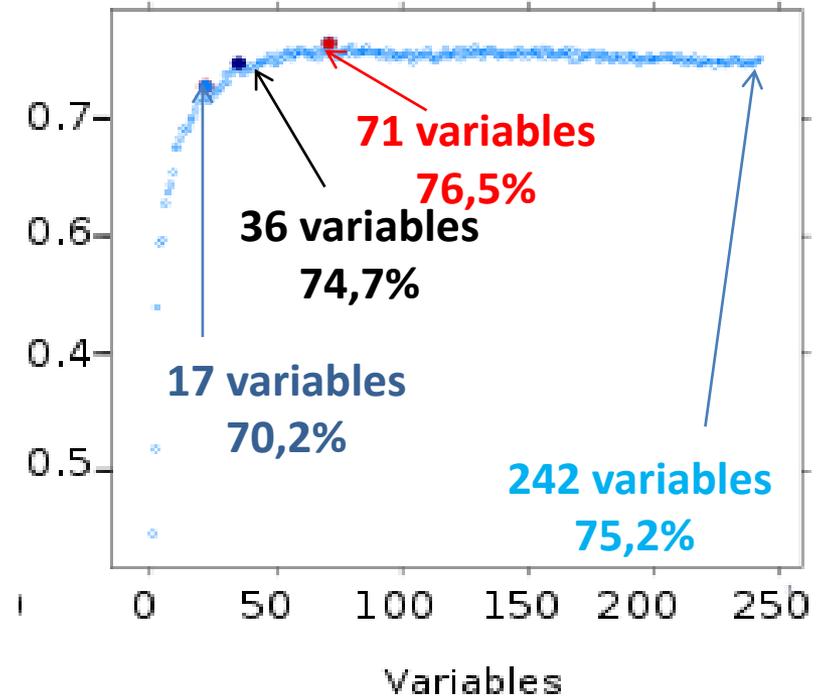At each level, a new classification is launched on the whole database.

2014 Results

Classification tests on input variables

Crop/non crop

**159 variables
94,52%**

**40 variables
94,45%**

**15 variables
94,2%**

**242 variables
93,9%**

Accuracy (Cross-Validation) vs *Variables*

Crop group

**71 variables
76,5%**

**36 variables
74,7%**

**17 variables
70,2%**

**242 variables
75,2%**

Variables

-> The best overall accuracy can be obtained with less variables
-> ~20 variables for a « thematically » acceptable overall accuracy

2014 Method
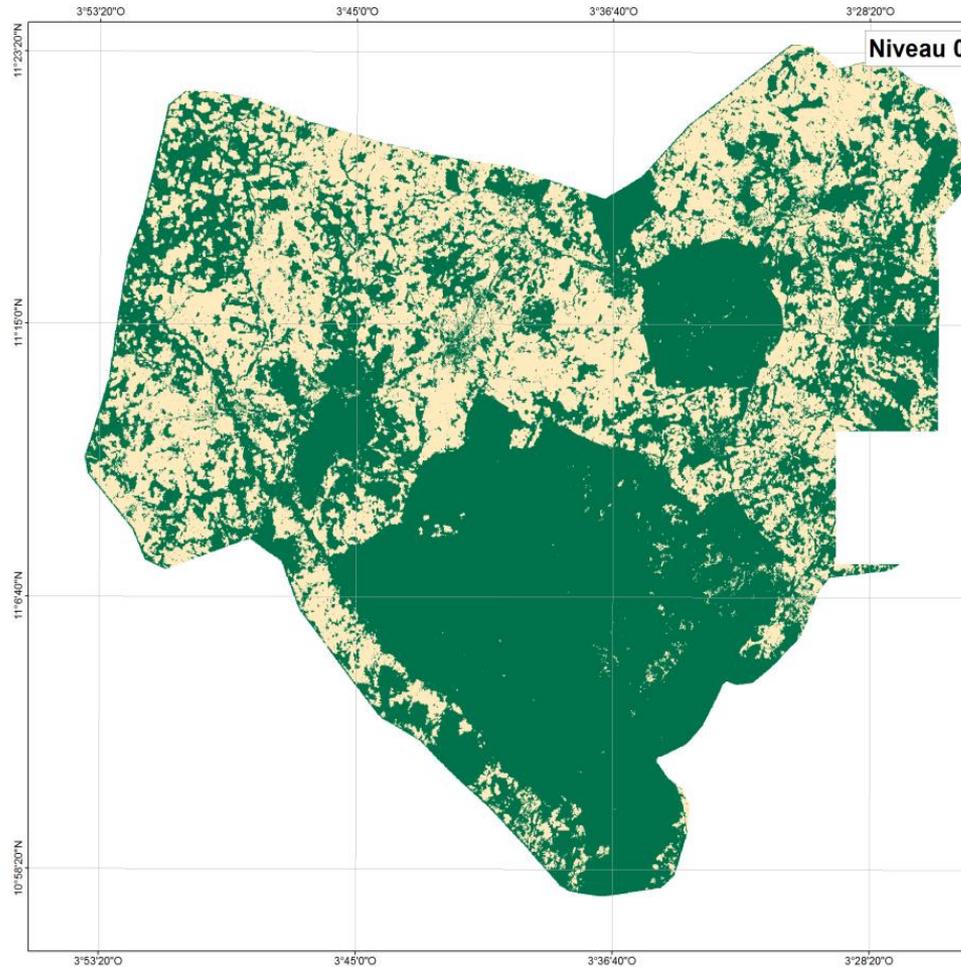
- Classification strategy recommendations
  - Hierarchical method (1st step : cropland map)
  - Need of a VHRS image to separate the non-cropland from the cropland (texture)
  - No advantage of using VHSR for crop group or type classification

  - ~20 variables
  - VIs better than reflectances
  - Key dates during the growing period

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2014 Results

Cropland map

Cartographie des zones de Cultures et Non culture Koumbia (Burkina-Faso, 2014) Niveau 0
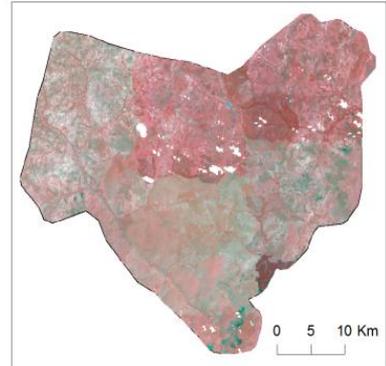
Niveau 0

Légende

Culture   Non-culture

Commentaire

Cartographie effectué au niveau 0, à partir d'un classification traditionnelle sur l'ensemble des 242 variables.
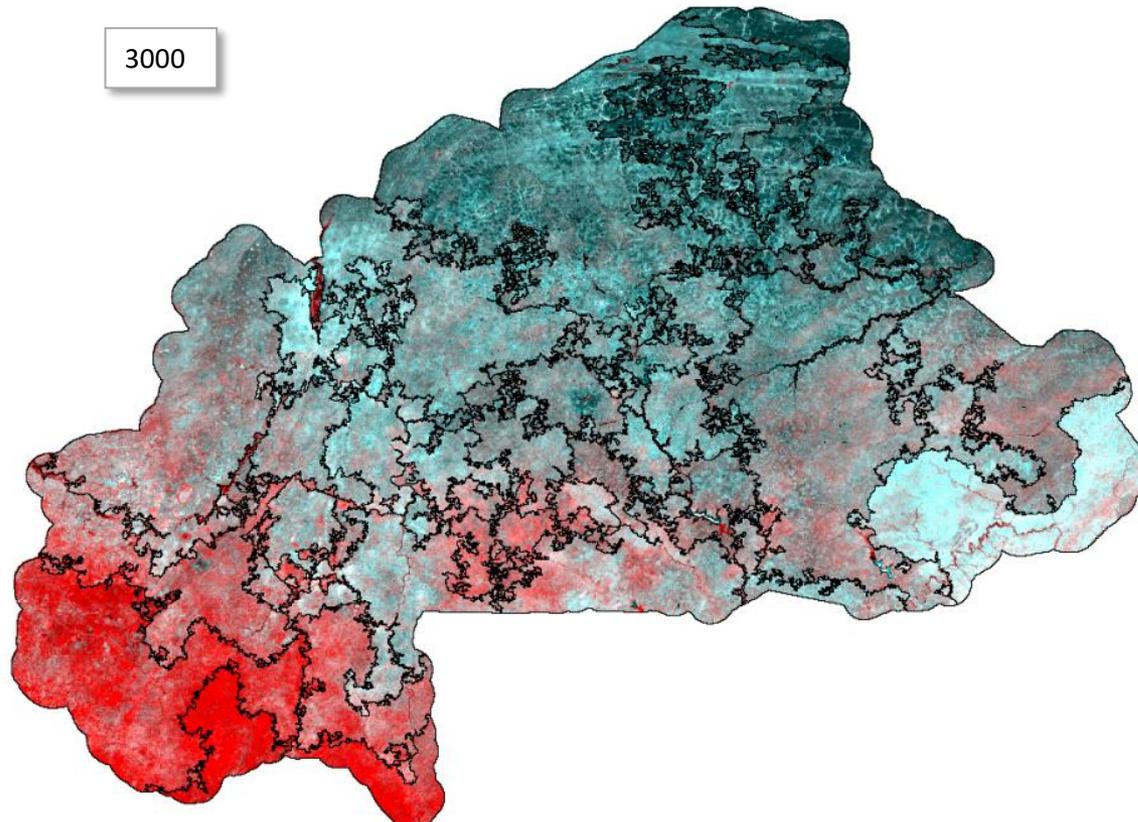
Données et systèmes de référence

Données
Images Pléiades Octobre 2014

Système de projection
UTM Zone 30 N
Système de coordonnée
WGS 1984

0   7,5   15 Km

Source : Production cartographique réalisée par Suzanne Butler, 2015

0   5   10 Km

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Other results

- Country stratification using MODIS time series

3000

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Research Plans for Next Growing Season

- Will you hold the course, or modify the approach?
  Improve the approach by :
  - *Multi-source data fusion (VHSR, optical-radar time series) + S2*
  - *Agrosystem stratification*
  - *Combination of spatial modeling (Ocelet) and image processing (SIGMA research)*
  - *Multi-year data analysis (5 years 2012-2016)*

  + 2016 ground campaign planned