Agriculture monitoring in countries at risk: remote sensing challenges

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LA RECHERCHE AGRONOMIQUE POUR LE DÉVELOPPEMENT

Countries at risk ?

Risk = Food insecurity

Food security is a complex condition, with 4 dimensions : **availability**, access, utilization and stability.

*"The environment for food and agricultural production is increasingly challenging – **particularly for smallholders** – due to natural resource degradation, more frequent and severe weather events, globalization (new forms of investment, new food system governance), urbanization and market concentration…."*
FAO source

FAO and the post-2015 development agenda, March 2014

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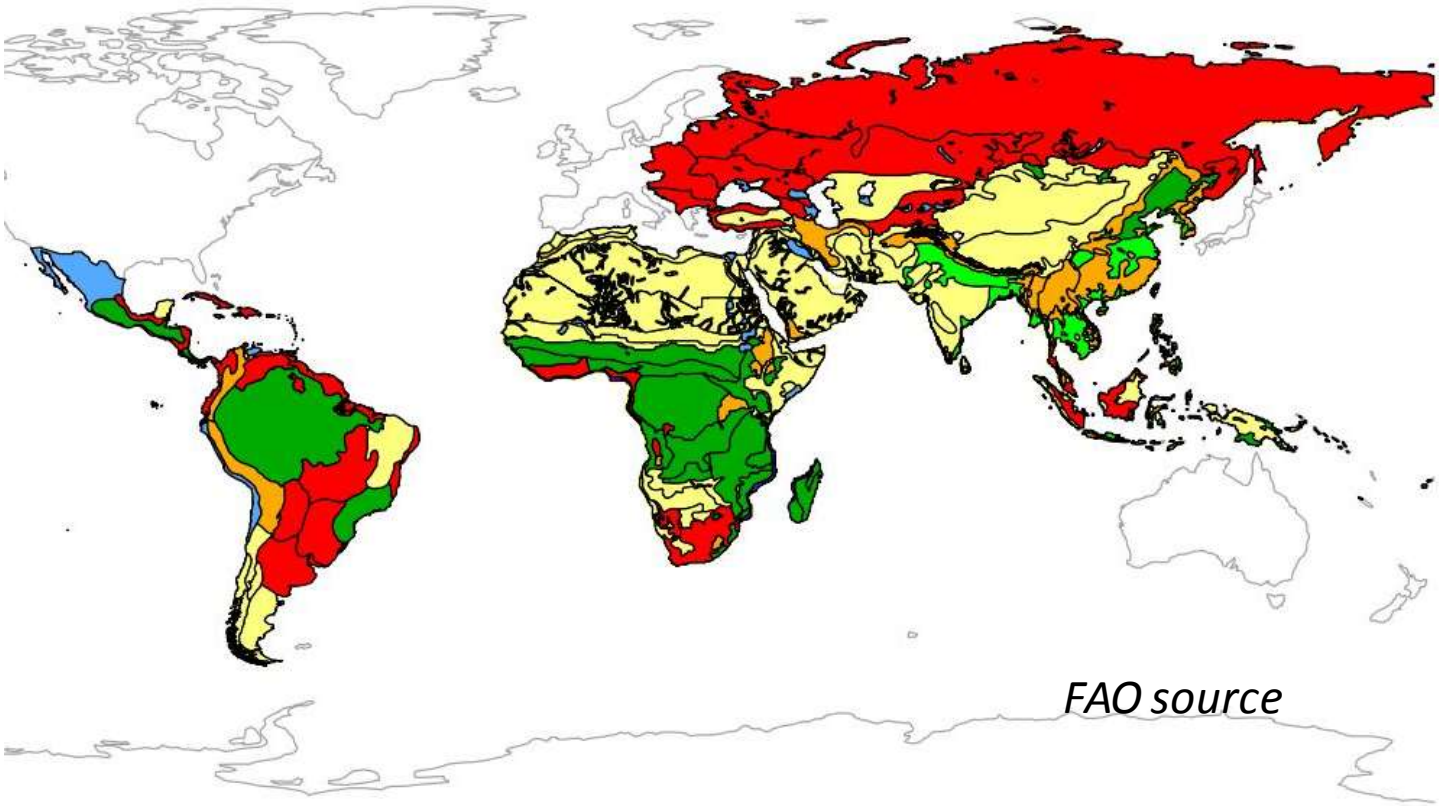

- Irrigated farming systems
- Wetland rice based
- Rainfed farming systems in humid (and subhumid) areas
- Rainfed farming systems in steep and highland areas
- Rainfed farming systems in dry or cold areas
- Mixed large commercial and small holder

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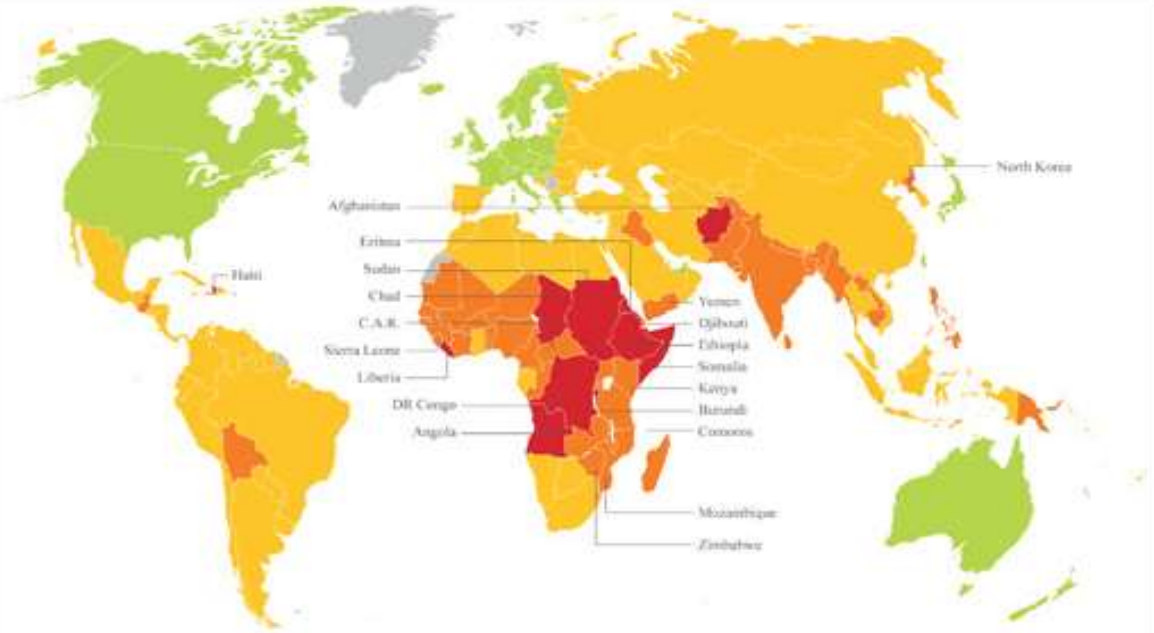
Food security index

Food Security Risk Index



Legend	
Extreme Risk	
High risk	
Medium risk	
Low risk	
No Data	

Rank	Country	Rating
1	DR Congo	Extreme
1	Somalia	Extreme
3	Burundi	Extreme
4	Eritrea	Extreme
5	Angola	Extreme

Rank	Country	Rating
6	Chad	Extreme
7	Ethiopia	Extreme
7	Haiti	Extreme
9	Afghanistan	Extreme
9	Liberia	Extreme

© Maplecroft, 2011

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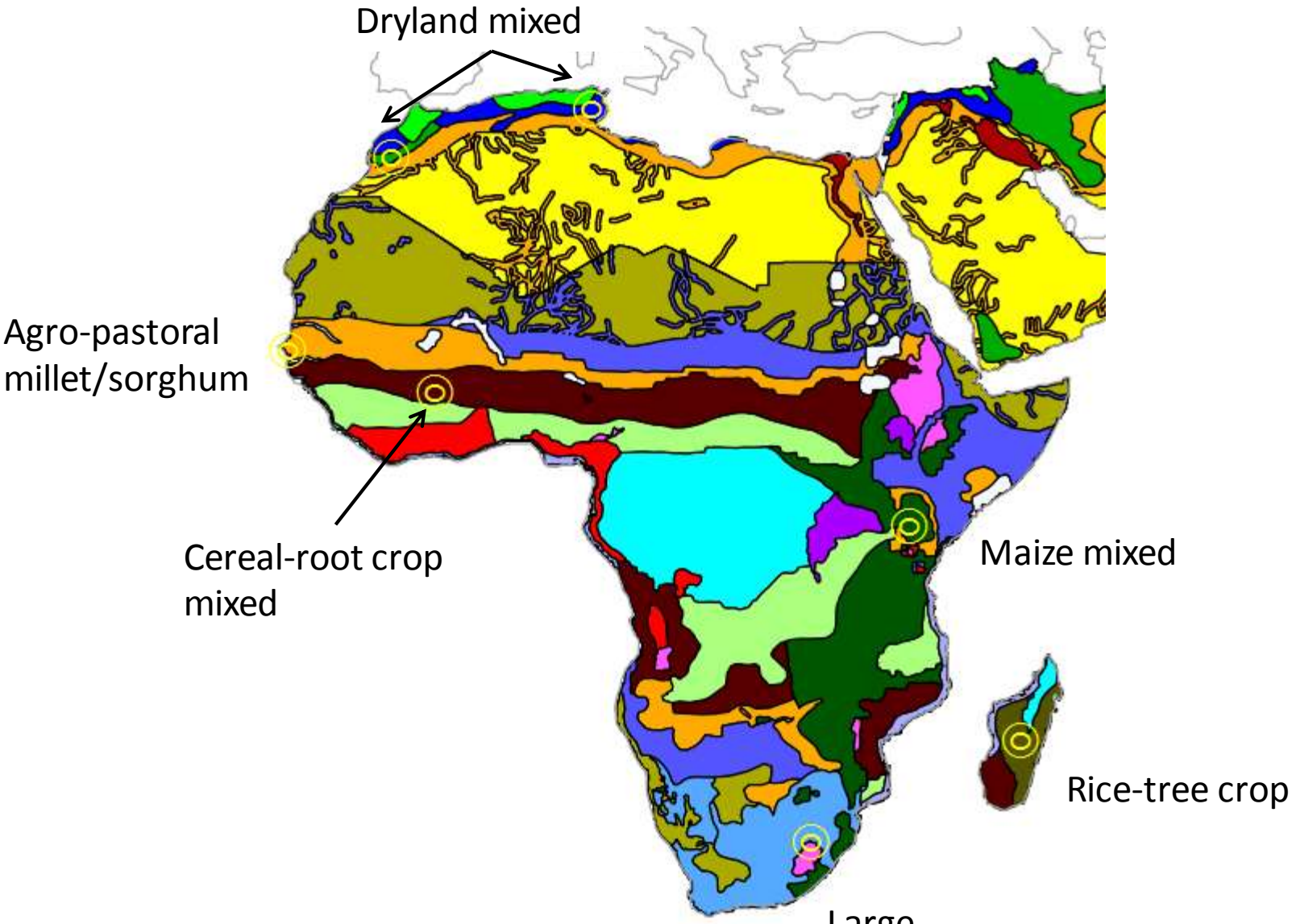

Farming system map, FAO
6 FS out of 20 FS

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Smallholder agriculture…

… a challenging agriculture in terms of Remote sensing

- Important cloud cover (inter-tropical area)
- Large variety of cropping systems
- Large intra-field variability
- Small sized fields
- Non-synchronous crop phenologies
- Presence of fallow
- Presence of trees in the cropland
- Highland agriculture
- Mixed Crops (cereals, agroforestry…)
- …

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Developing countries …

Remote sensing issues

- Small image archive (mainly dry season images)
- « Small-data » context (rainfall, soil, atmospheric data…)
- Difficulties in obtaining in situ (and statistical) data
- Difficulties in national collaborations (few RS scientists, technical limitations…)
- …

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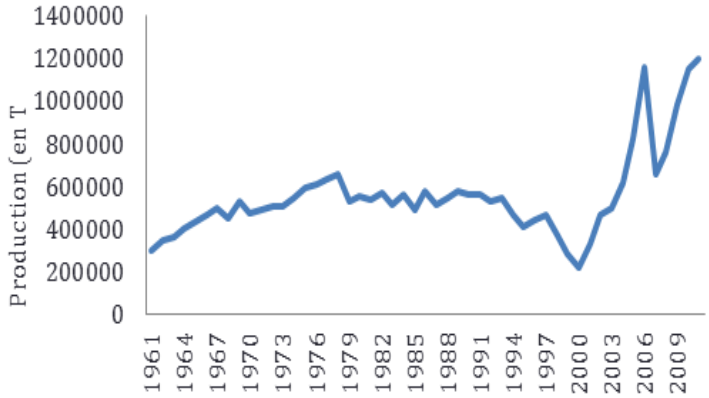
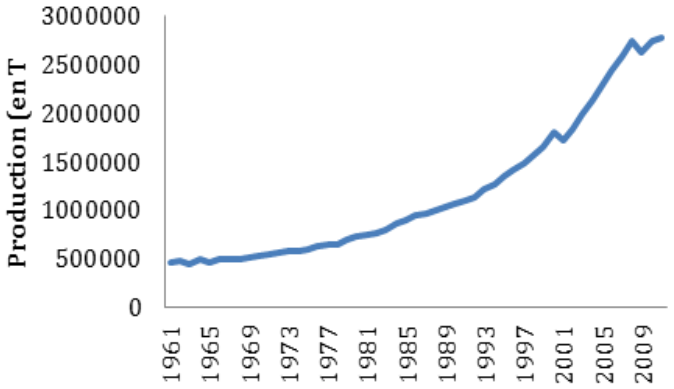
… but …

A challenging agriculture for remote sensing …

BUT with expected high gains because uncertain agriculture statistics.





FAOstats

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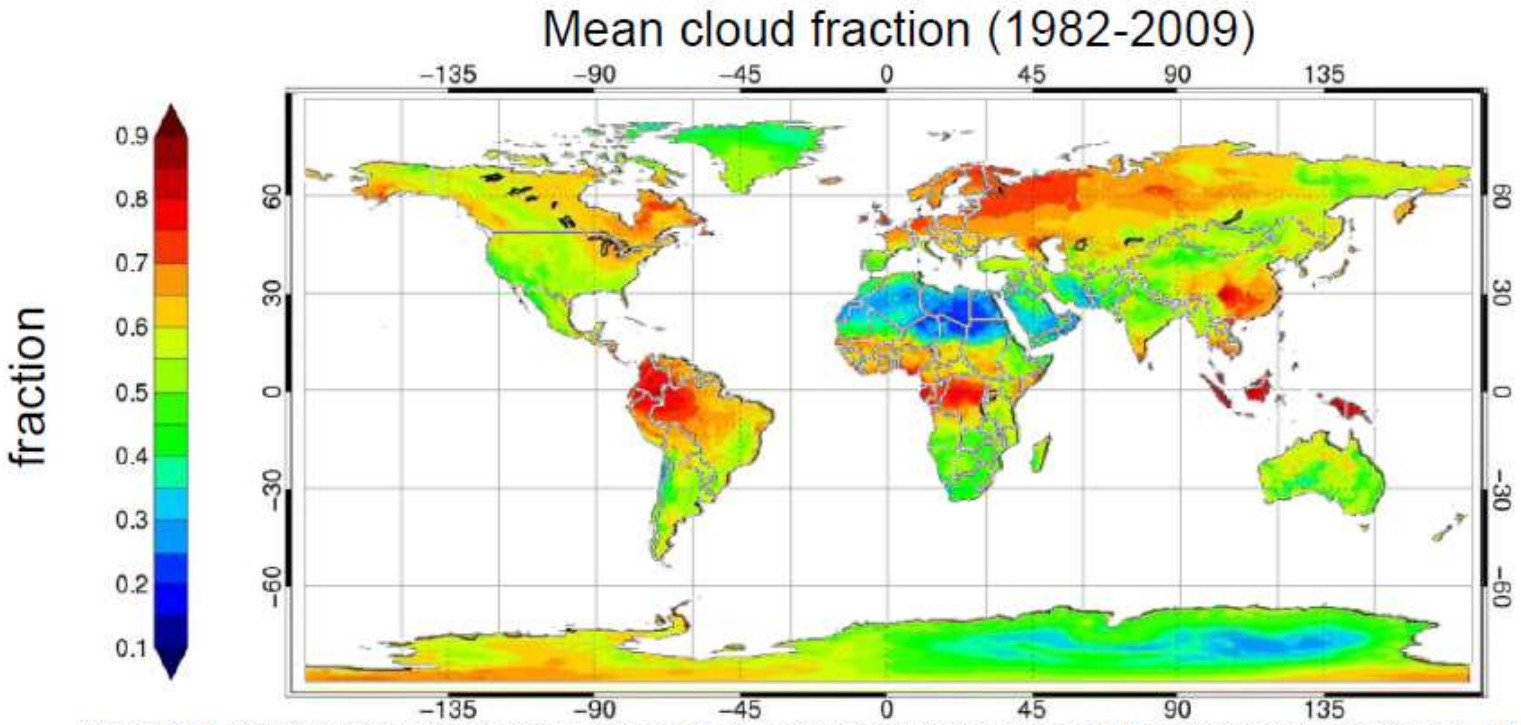
Cloudiness



CLARA-A1 dataset is a global dataset of cloud, surface albedo and surface radiation products derived from measurements of the Advanced Very High Resolution Radiometer (AVHRR) onboard the polar orbiting NOAA and Metop satellites (EUMETSAT).

http://wui.cmsaf.eu

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Intra-field variability

- Soil/sowing heterogeneity

Koumbia, Burkina Faso, Pleiades image, october 2012

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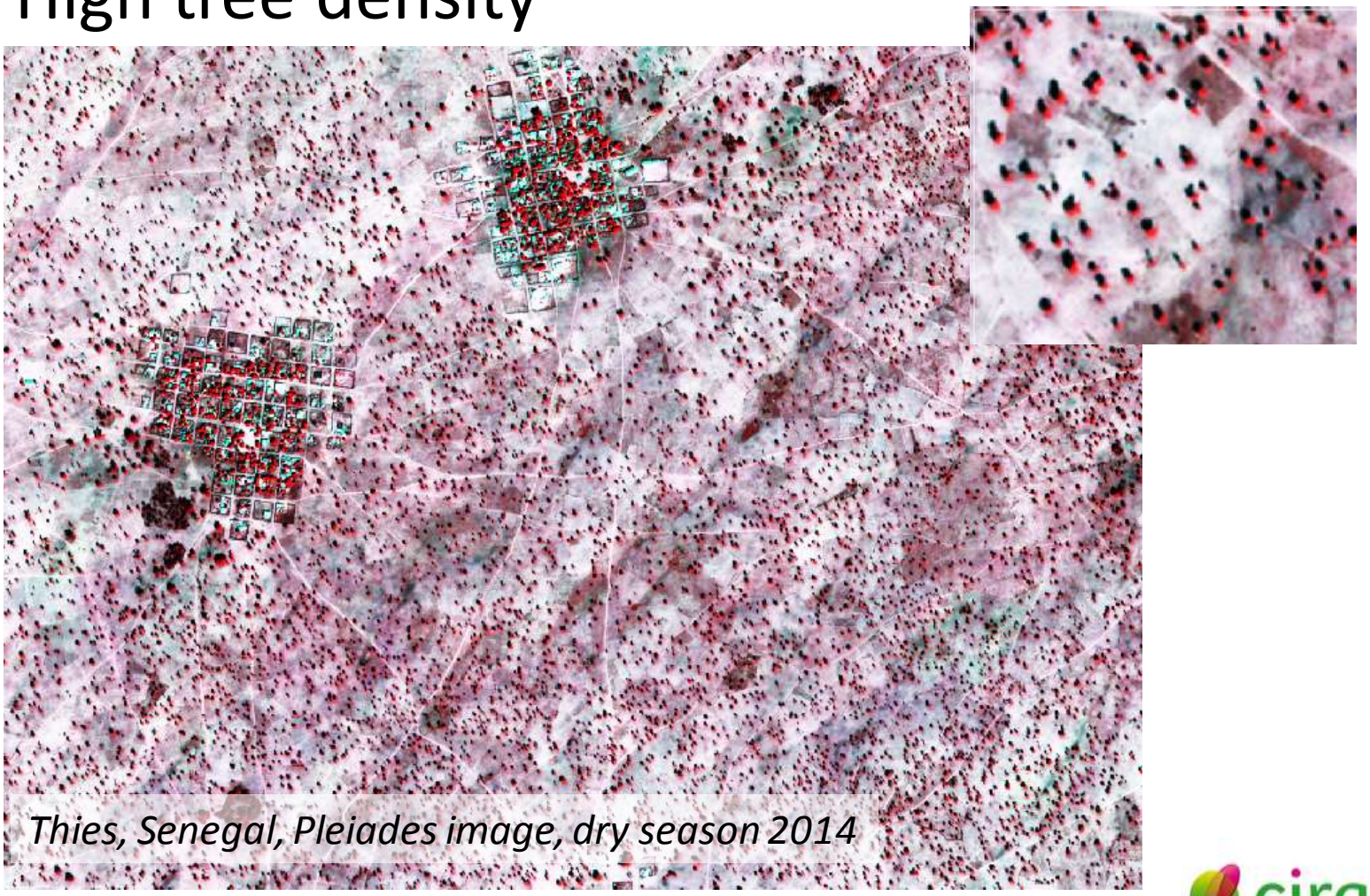
High intra-field variability

- High tree density



Thies, Senegal, Pleiades image, dry season 2014

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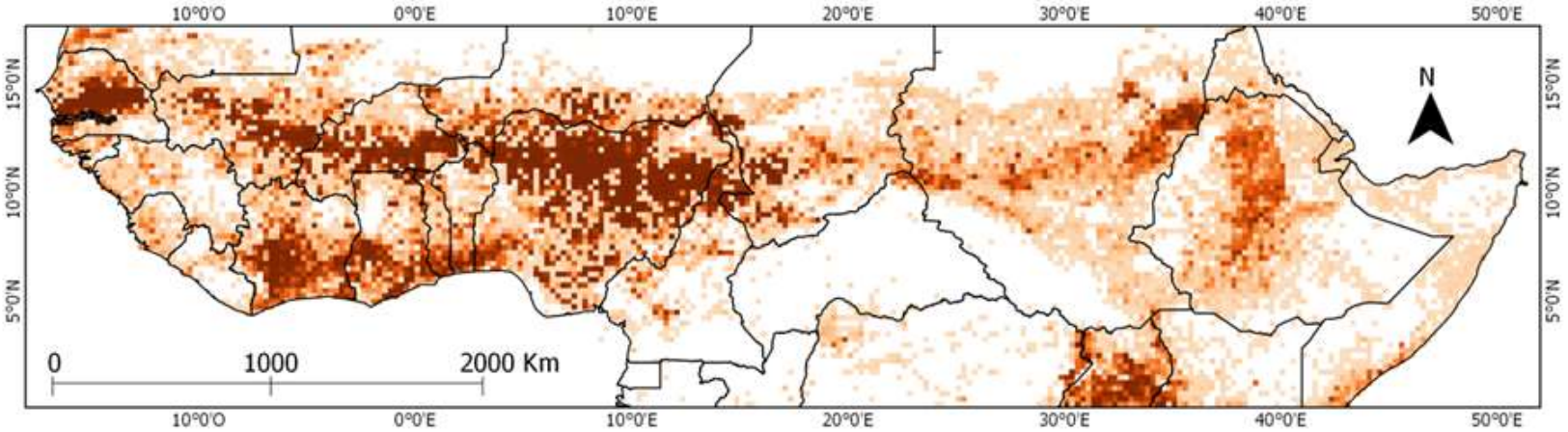
Cropland patch size

Map of MODIS cropland map accuracy:



Leroux L. et al., 2014. *Remote Sensing* (submitted june 2014)

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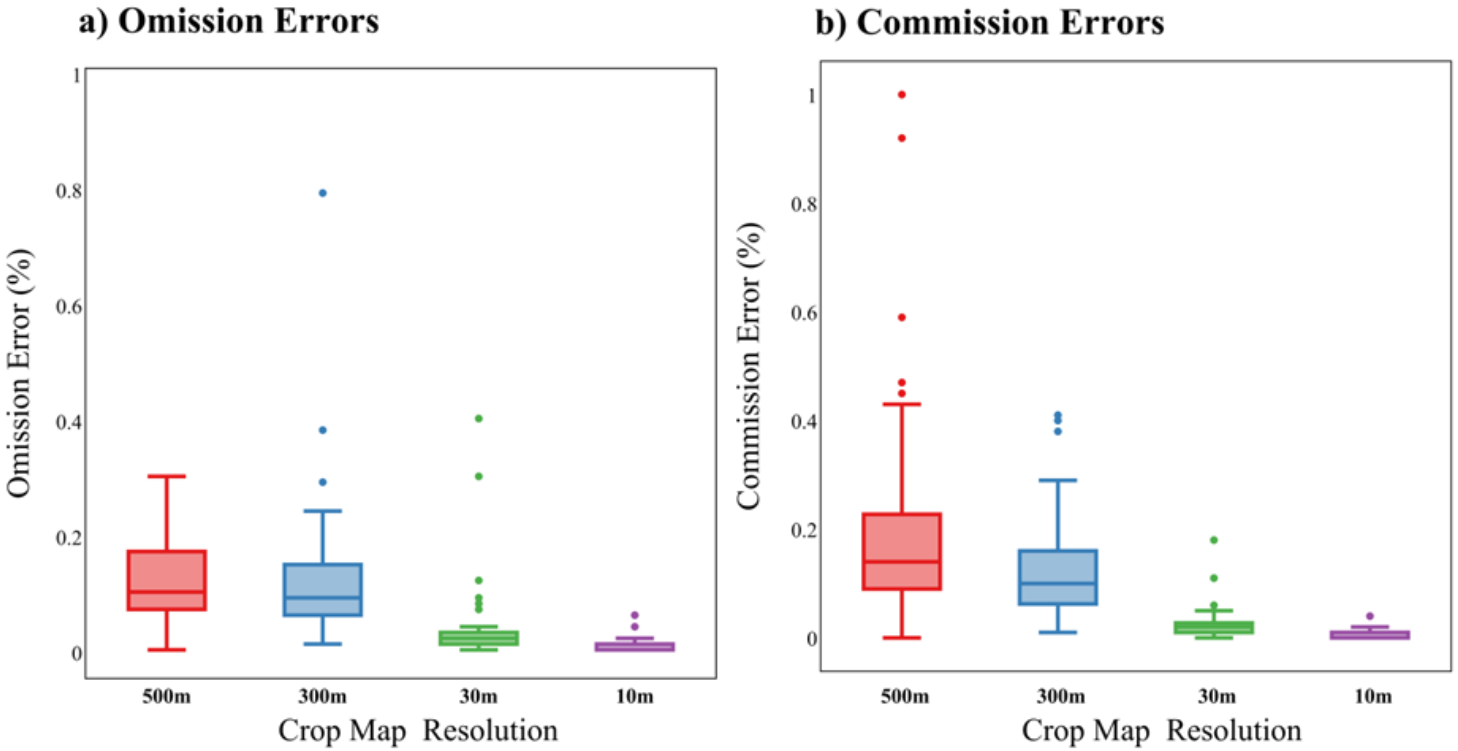
Cropland patch size

THEORETICAL ACCURACY



Leroux L. et al., 2014. *Remote Sensing* (submitted june 2014).

Plot/field patch size

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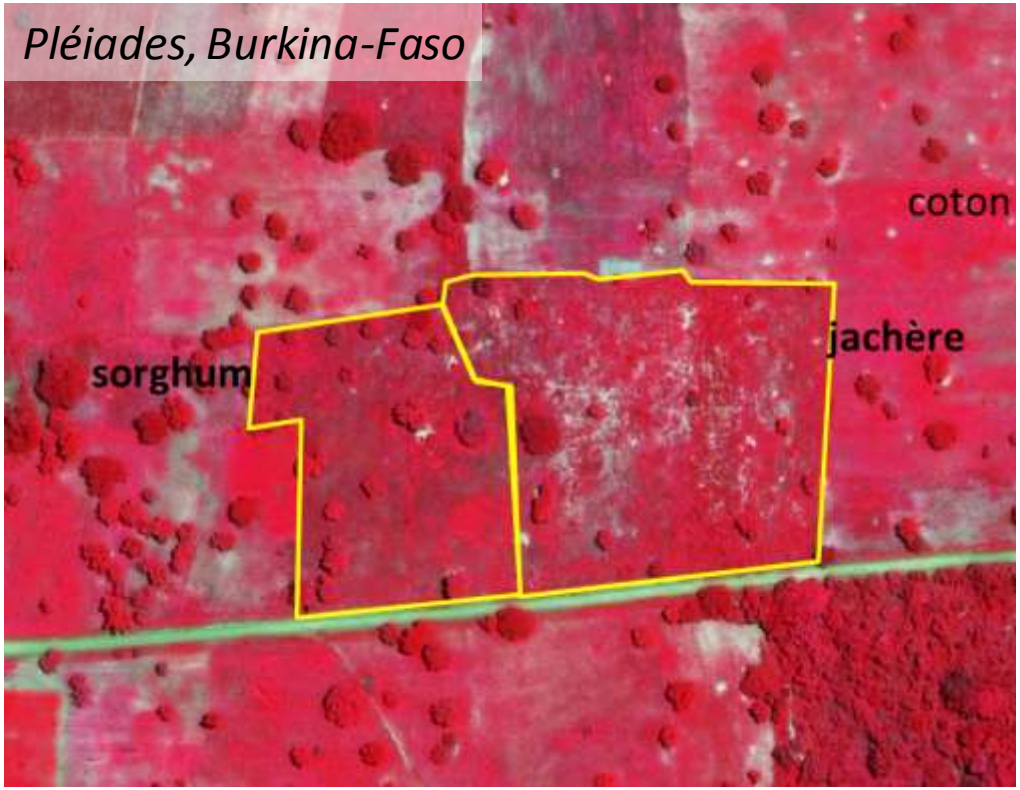
Fallow ?

- Definition of a fallow ?
- Spatial/spectral and textural indicators ?



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Mixed Crops

- Many associated crops
- Agro-forestry
- …

Photo: V. Lebourgeois

Photo: G. Lemaire

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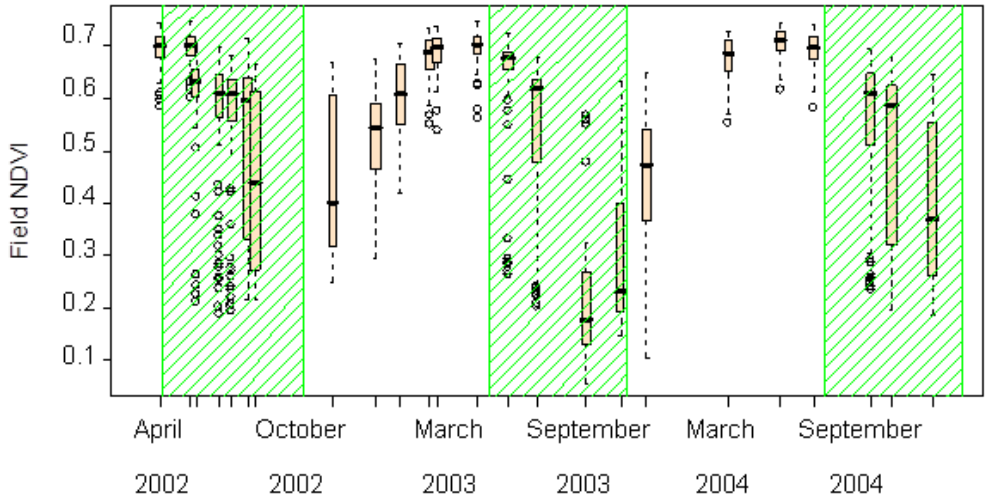
Seasonality

- Equator region: no season, no season-related crop phenology
- Dry tropics : short rainy season -> crops and natural vegetation grow at the same time
- BUT ALSO : Some tropical cropping systems are not season-related



Sugarcane example in the French West Indies
Begue et al., 2010

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Research axes

Need to be IMAGINATIVE !

- To forget regional agricultural monitoring at field scale
- To explore new ways of data processing (RS and others)
- To search indirect indicators of crop conditions
- ….

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Research axes

- Great hopes in **Sentinel-2** (in complement to similar sensors)
- **Use multiple sensors** : time series-VHSR, SAR ? SMAP ? SMOS ?
- **Stratification** to decrease spatial variability (zoning)
- **Cropland identification**, through structure and spatial analysis (OBIA ?)
- **Cropping system mapping** rather than crop type mapping
- **Crop conditions** : « pilot field » ?
- **Expertise** on driving factors of cropping systems and crop production -> indirect ways for mapping surface conditions.
- **Modeling** (how to use a crop model when crop properties are not accessible ?)
- …

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And now ?

- How can we conduct a collaborative reflexion on this subject ?
- So many points to treat, how to establish priorities (SIGMA…) ?
- ….

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