UAV-based remote sensing as a monitoring tool for smallholder farming

Elijah Cheruiyot
International Potato Center (CIP), Nairobi

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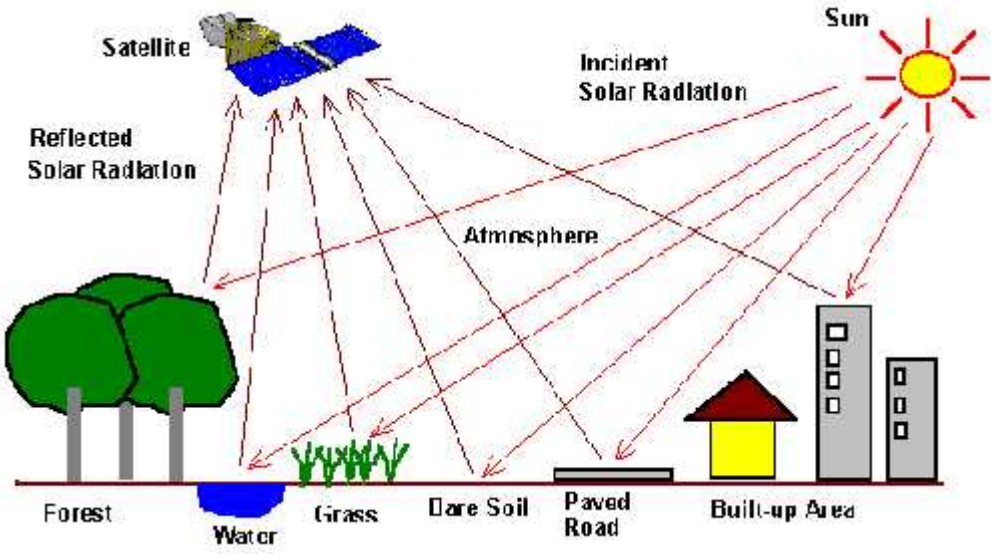
CENTRO INTERNACIONAL DE LA PAPA
CIP
A member of the CGIAR Consortium

UAV-ARSP

- Unmanned Aerial Vehicle (UAV) – Agricultural Remote Sensing Platform (ARSP)

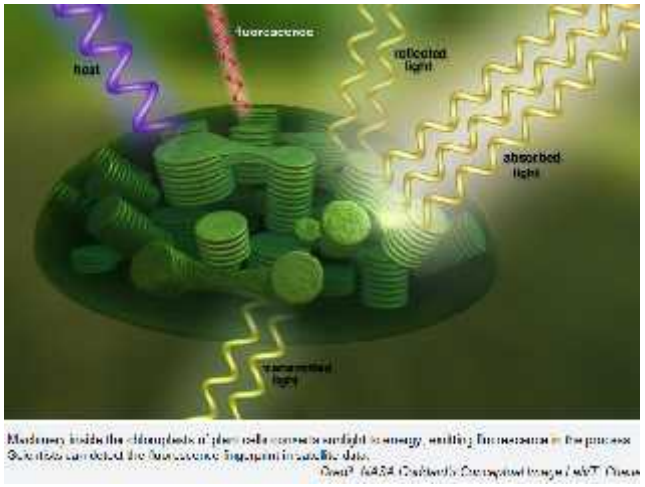
What, Why and How?

Remote Sensing in Agriculture



Credit: Centre for Remote Imaging, Sensing and Processing (CRISP)

Light-plant interaction



Application examples:

- Characterization of crops – stress detection
  - ✓ Infection
  - ✓ Water deficiency
- Crop discrimination
- Soil characterization

Why UAV?

- ✓ Low-cost
- ✓ Detailed information
- ✓ No clouds effect

ARSP at CIP - History

Balloons:
- Hot air.
- Hellium.

Model planes:
- Combustion.
- Electric.

Helicopter:
- Combustion.
- Electric.

Multirotor:
- Quadcopter.
- Octocopter.

ARSIS

- Agricultural Remote Sensing Information System

Objectives and Achievements

Project Objectives

- The aim of this “proof of concept” project is to develop and validate a low-cost UAV-based remote sensing tool for crop area determination (ARSIS) using sweetpotato as a pilot crop

- An out scaling plan that describes a path forward for the validated UAV-ARSIS, as a logical next step of the “Proof of Concept” project.

Inception Workshop – October 2014, Nairobi

32 Participants:

- National, Regional and International institutions
- 5 CGIAR Centers (CIP, ICRAF, CIAT, IITA and ILRI), and ICIPE

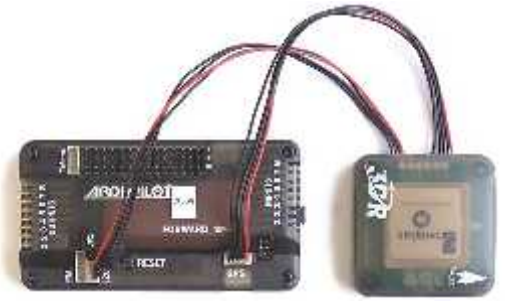
Key Highlights:

- Costs, accessibility, and user-friendliness
- Involving local institution at different stages is a must
- Stepwise – From simple to complex tools
- Complementarity with satellite imageries
- Multiple crops
- Yield assessment?
- Is it feasible to discriminate varieties?

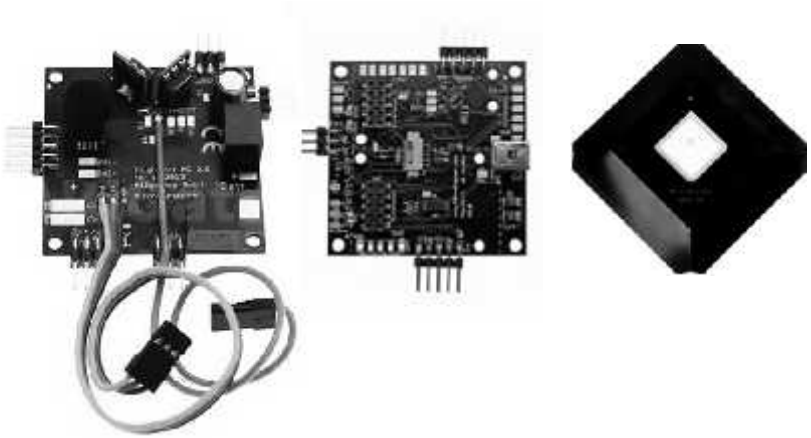
Hardware: UAV Platform

Quadcopter Open Source

Quadcopter Open Source based on Ardupilot



Ardupilot's Electronic System
$250

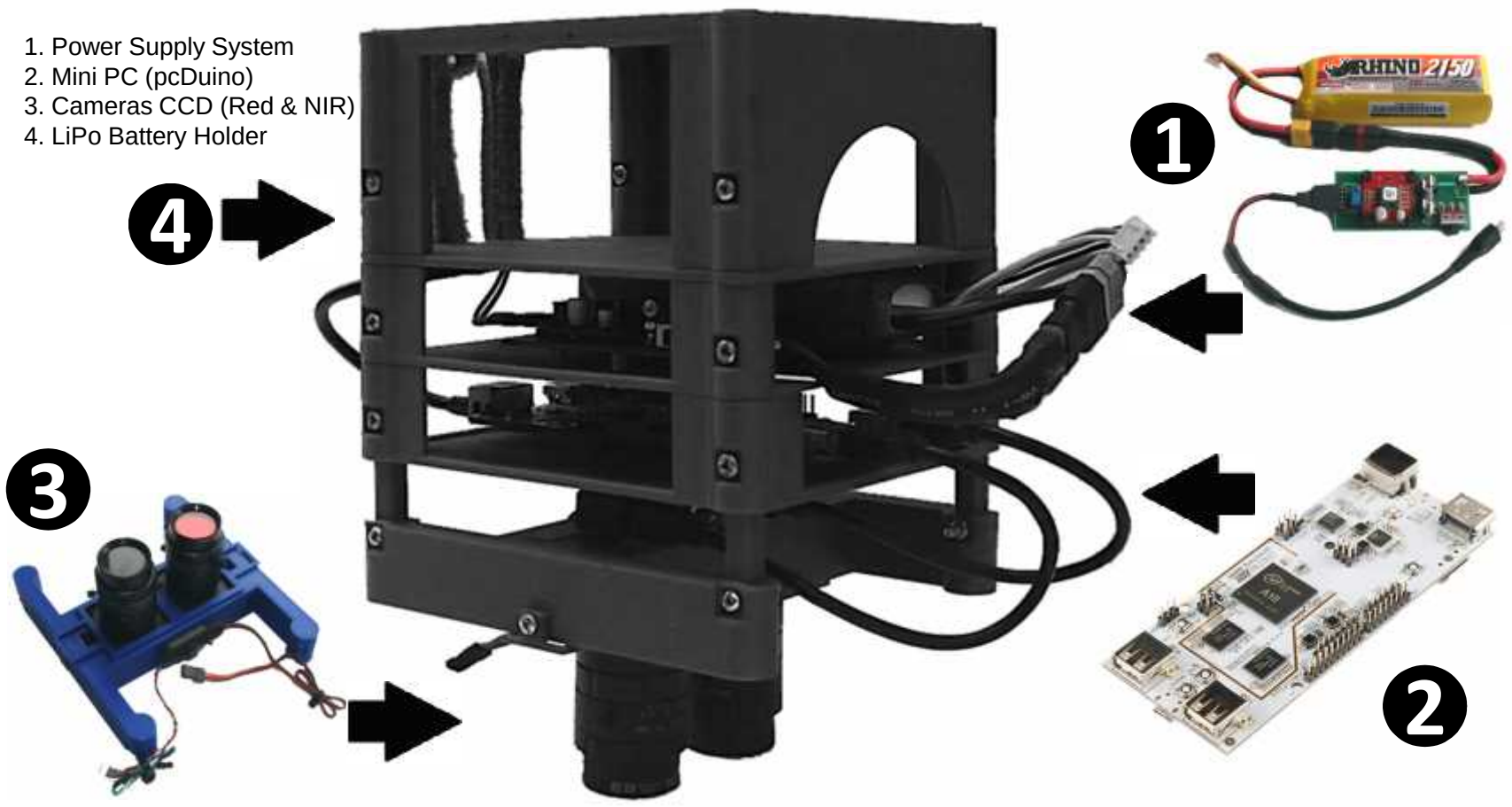


MikroKopter's Electronic System
$740

Hardware: Data Acquisition System

Locally Assembled Multispectral Acquisition System

1. Power Supply System
2. Mini PC (pcDuino)
3. Cameras CCD (Red & NIR)
4. LiPo Battery Holder

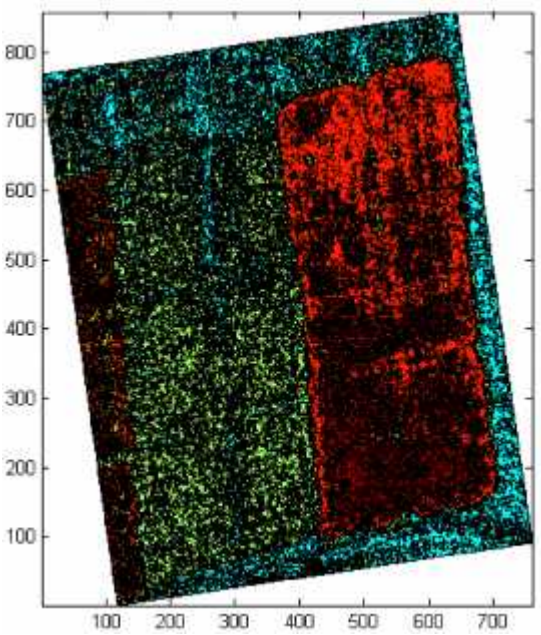


Acquisition Multispectral System Assembled

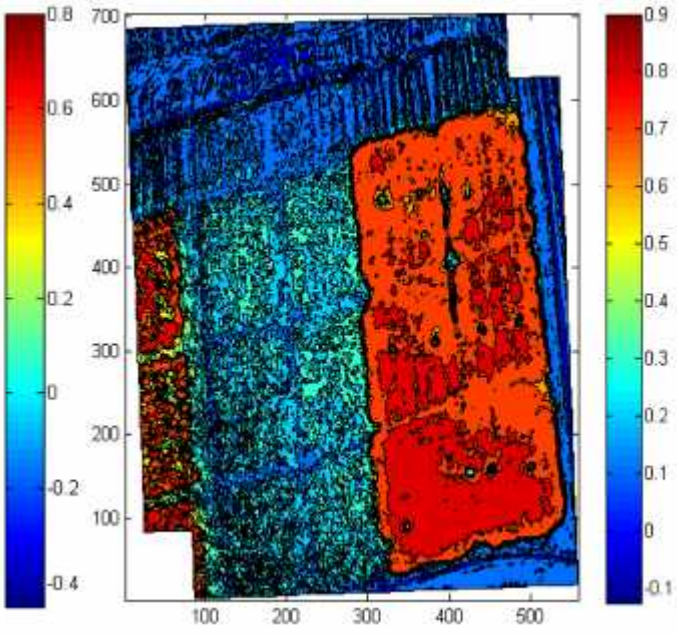
Hardware: Sensors

Reducing Camera Cost While Improving Image Quality

RGB Original Image – Canon EOS



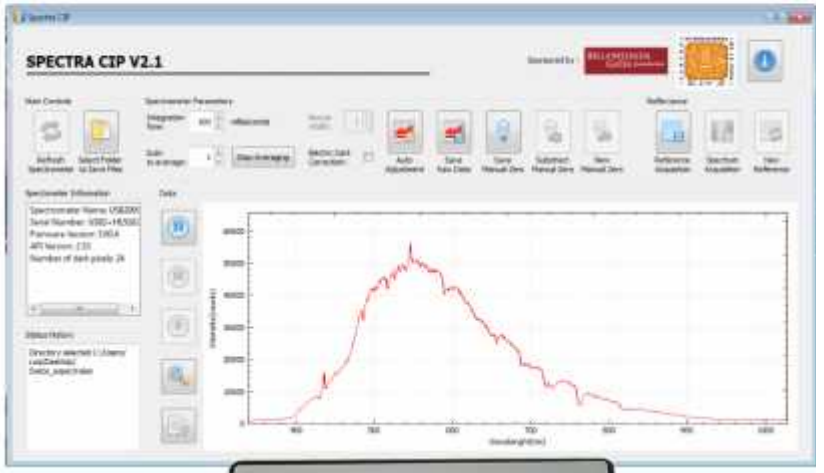
NDVI with TETRACAM ADC Micro



NDVI with CIP Built Camera

Software: Spectral Data Acquisition

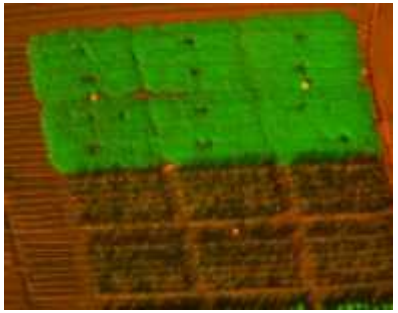
Spectra-CIP Software

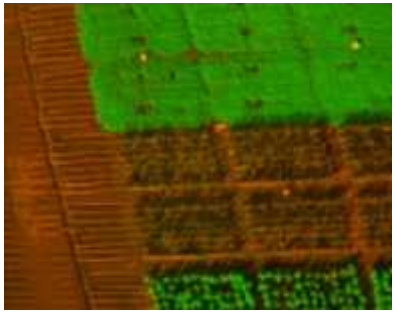


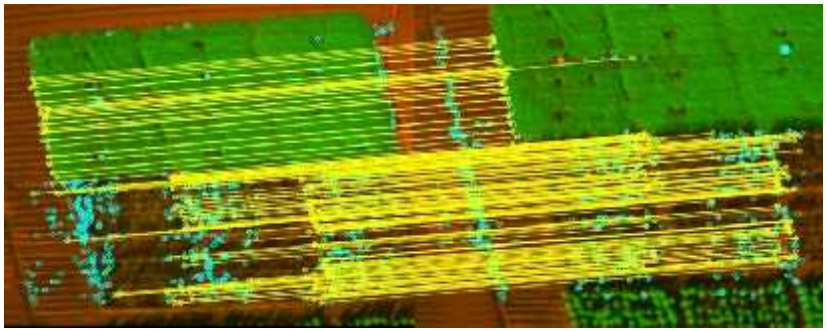
USB2000+VIS-NIR-ES Spectrometer

Software: Mosaicking

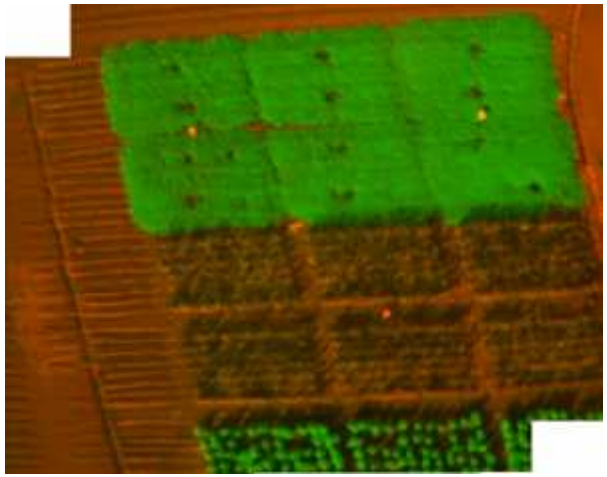
Image Stitching Software







High Resolution Mapping using Stitching Algorithm



Mosaic produced

UAV Assembly and Fieldwork

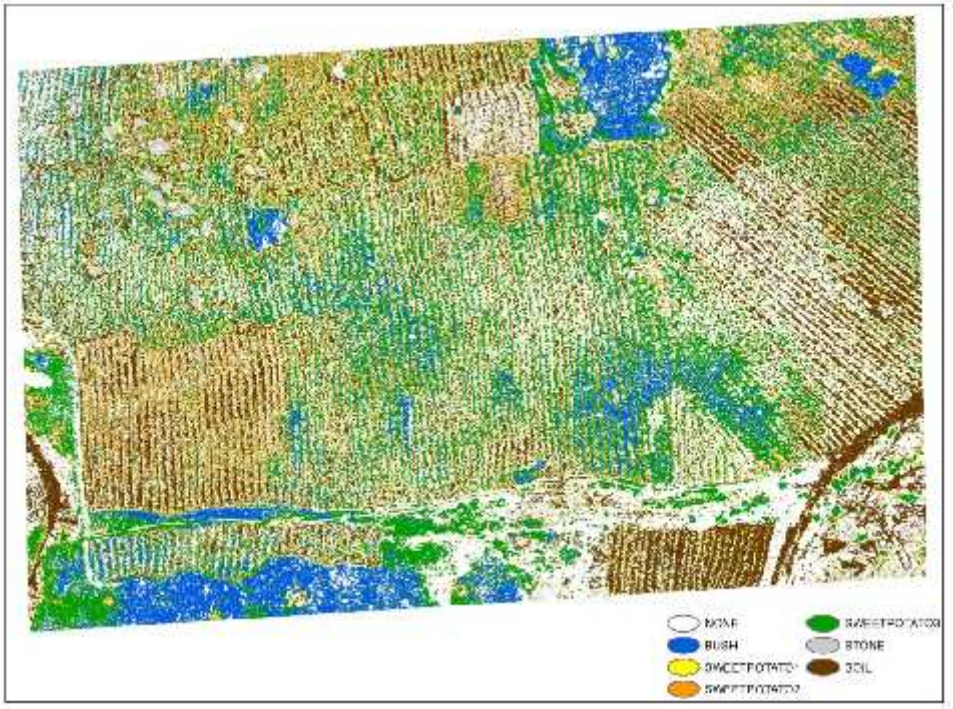
- A Community of Practice established comprising:
  - Core Developers
  - Application Scientists
  - End Users
  - Enablers
- Online platform (UAV4Ag) established

- UAV assembled in collaboration with ICRAF and UoN
- Field mission conducted in Mwanza with support of CoP in Tanzania

Processing: Crop Discrimination

Texture-based Classification

Crops identified from images taken with regular digital cameras



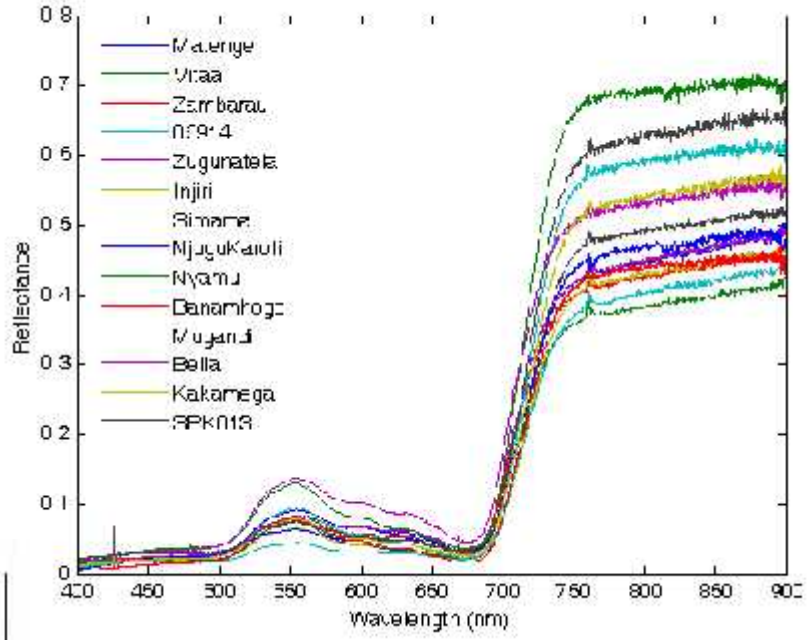
Better classification results could be obtained with multispectral imageries, but this require special equipment and knowledge

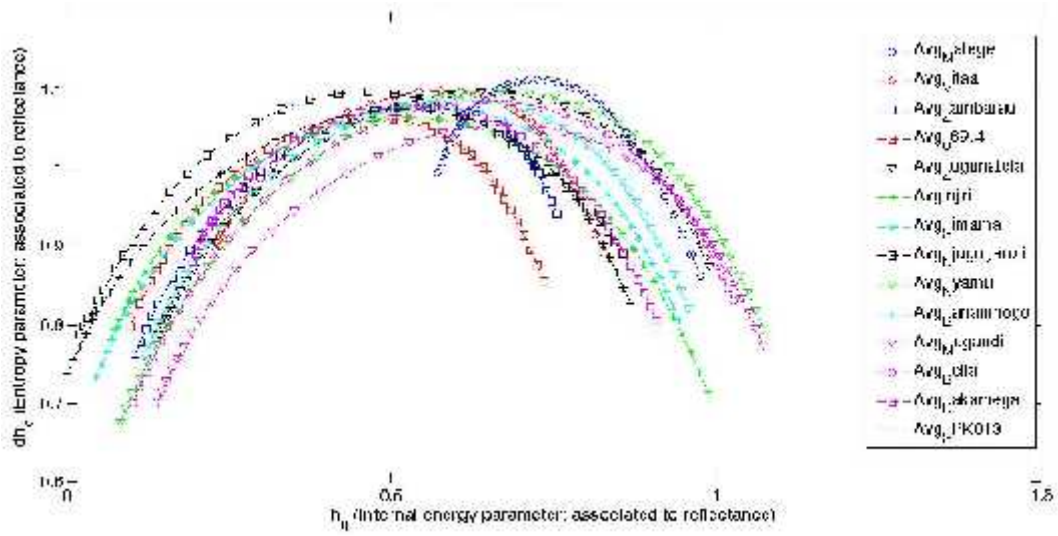
Processing: Variety Discrimination

Non-linear Processing Methods

14 Sweetpotato varieties at LZARDI experiment, Mwanza

Optical spectra





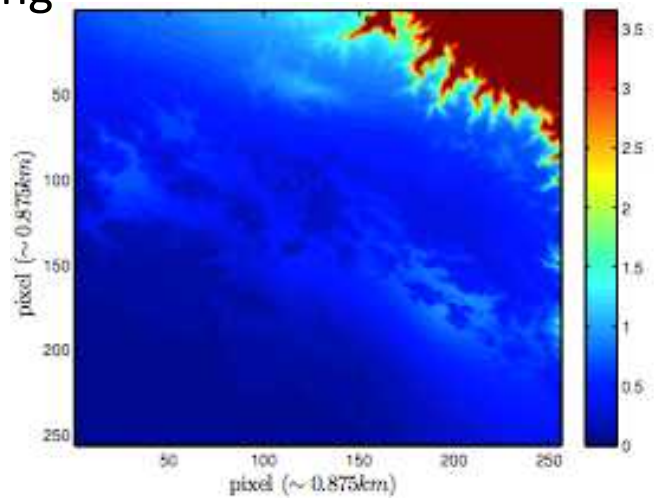
Multifractal spectra

Way Forward

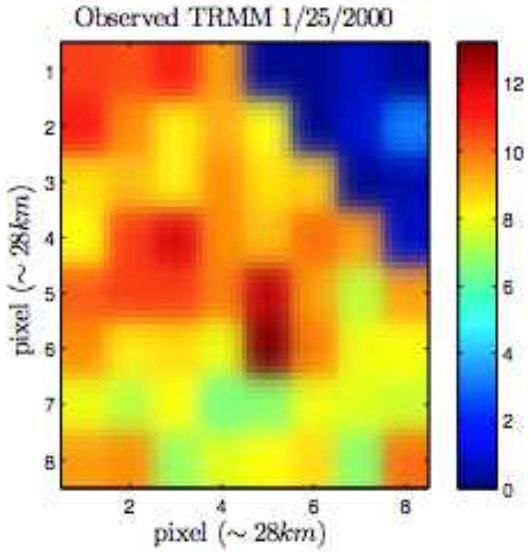
Planned Activities

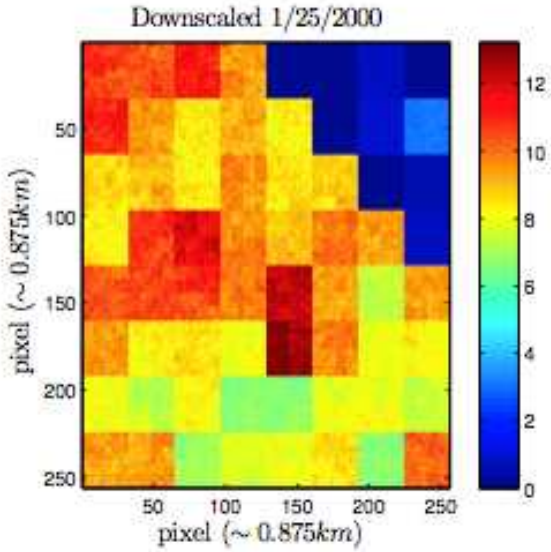
Complementarity with satellite imageries

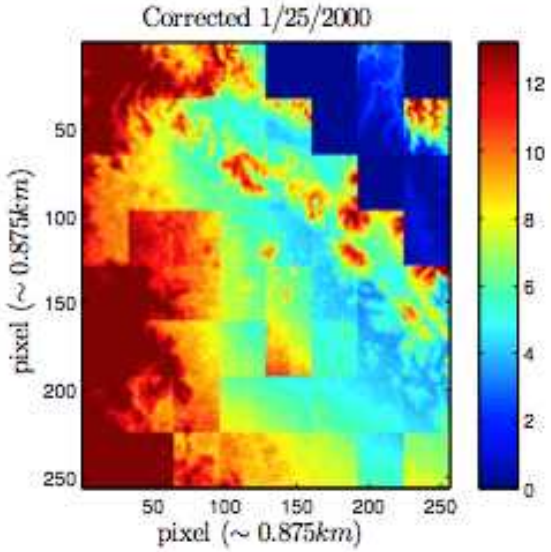
Multi-fractal Scaling



- Spatial measurements are upscaled / downscaled and corrected with a base of ANUSPLIN heterogeneity
- Method yet to be tested with crop distribution







Planned activities

- Data acquisition field missions in Uganda, Kenya

- Second stakeholder Workshop in March 2016 – share progress and discuss regulatory frameworks in the region

- Expand our CoP within the region, e.g. Rwanda

Learn More!

Videos:

- AgroTV–16 – Spanish;
- ARSIS Video – English;

Blog Posts:

- Invasion of the Potato Drones – Lima;
- Community of Practice – SSA;
- UAV Assembling – SSA;
- Crop Discrimination;

Photos:

- Testing the Unmanned Aerial Vehicle – Flickr;

Join UAV Community on Online Platforms:

- UAV4Ag on DGroups;
- @UAV4Ag on Twitter.

Thank you!

Q/A

Contributing authors:

Elijah Cheruiyot
Arnold Bett
Adolfo Posadas
Dieudonné Harahagazwe
Hildo Loayza
Susan Palacios
Mario Balcázar
Luis Silva
Roberto Quiroz

Contacts:

Roberto Quiroz, PhD
R.Quiroz@cgiar.org
International Potato Center (CIP)

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