STARS — Project Overview

G4AWeek

Advances in Remote Sensing
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Rolf A. de By

HIGH TECH
HUMAN TOUCH

UNIVERSITEIT TWENTE.
Project synopsis

Spatial information is revolutionizing agriculture in high-income countries but not in low-income countries. Here, important adoption barriers exist: heterogeneity.

STARS: coordinated effort to

– learn,
– identify opportunities, constraints & risks,
– test hypotheses

around potential **exploitation of very high-resolution RS technology in crop-based production systems and livelihoods of smallholders.**
Objectives

• Better understand
  – why RS has not been taken up for SHA, and
  – which investments are required to unlock potential.

• Demand-driven experimental use cases where currently poor information is the norm, and where RS-based workflows can help improve.

• Match
  – direct stakeholder information needs,
  – private sector partners with
  – public sector actors and
  – public good objectives.
Three facets

- **Technology**
  - information products that inform & transform agricultural processes

- **Stakeholder**
  - sustainable models of realization

- **Business**
  - ground-based, airborne, and spaceborne monitoring throughout the crop season
Main hypotheses

We think *we can*

- *monitor crop growth* within the small farms of sub-Saharan Africa and Southern Asia, *using time-series remote sensing*.

If achievable, *this will*

- allow *improved outlooks for crop yields* throughout the season, *informing policy-makers*, and
- ensure more effective evidence-based advisory services at the farm scale, *informing farmers and the small agro-business around them*. 
Project facts

• Five partners:
  – ITC,
  – ICRISAT
  – University of Maryland
  – CIMMYT,
  – CSIRO

• 26 months = 1 or 2 crop seasons per region
• Supported by DigitalGlobe & RapidEye data & knowledge contracts
• Started June 1, 2014 will run to July 31, 2016
• Various subgrants/-contracts: Manobi, Uni Sokoine, ESIPPS, BIID, ...
• Budget M$8.7, grant M$7.7
Challenges

Heterogeneity in

- Crops and crop varieties
- Cropping systems
- Soils and nutrient content
- Climatic conditions
- Farm field practices and consistency
  - Farm field boundaries
  - Tillage and planting system
  - Rain-fed vs irrigated fields
  - Use of fertilizers
  - Use of mechanization
Compared to high-income ag

• Smallholder farming in Africa/Asia is a *data-poor* context; there are many facets of the production systems that we do not know.
• Tanzania 2008 maize bumper crop
• Much ground truthing required

• Build an infoconomy with the farmer as active partner?
Where we work

bottom-up, farmer-first
top-down, government-first
mid-level: SME-first
STARS Image Data Stack

250/500 m spectral — 1.5 days — 36 bands

12x

15 m pan/30 m mspectral — 16 days — 8 bands

6x
tasked per 14 days —
5 m mspectral — 1 day — 5 bands

2x
tasked per 14 days —
30-40 cm pan /1.24-3.70 m mspectral — 4.5 day — 8/16 bands

20x
tasked per 14 days —
2-10 cm RGB / 2-10 cm mspectral — 1 day — 5 bands
STARS Data collection

UAV data

eBee
- GR+NIR 12 Mp Canon camera, 3.5cm resolution (5cm vertical)
- GRRe+NIR 4-band 1.2Mp multiSPEC camera, 10cm resolution

Geo X-8000 Octocopter
- Tetracam miniMCA 5/6-band 1.3Mp, 10cm resolution
- RGB Sony NEX-7 24 MP, 2cm resolution
- OPTRIS PI 400 thermal camera, 1.1 Mp, 15 cm resolution

Challenges
- HW robustness, stitching, spectral calibration
Field data

Intensive field campaigns
- Crops and cropping system, crop management
- Plant density & height
- Phenological development
- LAI, fCover, Yield
- Spectrograms
- In-field variability
- Fertility trials

Challenges
- Cloud cover
- Off-nadir angles
- Pre-processing (atmosphere/geometry)
- Analytical processing
- (Licenses)

fCover estimation from pictures taken in the field, making use of plant/soil classification
Public good outcomes

• Landscaping study — CSIRO & partners
  Aim to understand
  – the decision-making environment for key stakeholders
  – the pathways for agricultural development that are likely to emerge
  – the nature of the infrastructure systems needed for delivering the right information to the right stakeholders at the right time.

• Crop Spectrotemporal Signature Library — ITC & partners
  – Spectral info for crops followed over time
  – Accompanying farm field data

• Image analysis algorithm repository — ITC & partners
  – Data ingestion workflows
  – Analytical workflows
Finally: differences with G4AW

- Focus on next-frontiers
- Focus on VHR RS, spectral characters of crops
- Focus on eventual economic development, not (now/necessarily) on business generation
- Focus on stakeholder classes
  - Poorest of the poor
  - The one-(wo)man SME
  - The national government
UNIVERSITY OF TWENTE.

DR. IR. R.A. (ROLF) DE BY
Associate Professor
Department of Geo-Information Processing
Faculty of Geo-Information Science and Earth Observation

P  +31(0)53 4874 553  E  r.a.deby@utwente.nl
M  +31(0)6 4604 2254  I  www.utwente.nl/en
F  +31(0)53 4874 335  I  www.itc.nl

P.O. Box 217
7500 AE Enschede
The Netherlands

Building ITC
Hengelosestraat 99
7514 AE Enschede